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PREFACE.

THE exigences of the Profession seemed to require, for the department of Operative Dentistry, a work that should contain all that is known in this branch of the science. To answer that requirement, the author of the present work has aimed to furnish, in as compact a form as possible, the Principles of the Science, properly digested, the Experiments Detailed, the Manipulations Described, and the whole methodized and thus made available to the Student and the Practitioner. In the accomplishment of this object, he has, he believes, included everything meritorious or important in this department of Dental Study.

To the dental writers whose labors have lightened, in any degree, the toil of this undertaking, the intelligent reader will ascribe the credit due; and to the members of the profession, whose suggestions have found place in various parts of the volume, the author gratefully acknowledges his obligations.

J. TAFT.

CINCINNATI, July 1, 1859.

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OPERATIVE DENTISTRY.

CHAPTER I.

INTRODUCTION.

As introductory to the following treatise, a cursory consideration of those conditions and diseases of the teeth which demand the aid of dental surgery, would seem appropriate. To refer, however, to all of these, or to remark extendedly upon any of them, would not be consistent with the design of this work, or necessary to a proper understanding of the subjects proposed. Only those affections which pertain to the teeth directly, and which, for the most part, are confined to the tooth-substance itself, will here require attention. Nor will the pathology of contiguous parts be introduced; for the appropriate treatment of these, being mainly therapeutic rather than surgical, would involve a discusssion of questions not within the scope of the present volume. Indeed, it is proposed merely to speak of those affections of the teeth, which generally suggest surgical remedies, and which are implicated more or less in the operations described in the following pages; and first, of

DEPOSITS.

In this term are included those calcareous formations commonly called *tartar*, a certain coloring matter denominated *green stain*, and such other impurities on the teeth as result from neglect, the use of tobacco, and like causes. The word

TARTAR

Implies all calcareous deposits upon the teeth. Of this substance there are several varieties, the more obvious of which have respect to color and consistence. In color, there are all shades, from a white as light as that of the tooth, or even lighter, to a jet black; and in consistence, all degrees, from a thick, gummy mucus, to the density of the dentine itself. The color will, in most cases, be indicative of the density, the lightest shade corresponding with the softest, and the darkest with the hardest consistence. The tenacity to the teeth is also in proportion to the density, the dense and dark adhering most firmly. The density of the deposit, too, is generally indicative of the rapidity of its formation, being in an inverse ratio to this.

All the varieties of tartar are composed principally of the same elements,—phosphate of lime, fibrin, fat, and animal matter being contained in them all, though in various proportions. The fact that some varieties are soluble in acids, and others not, has been adduced to prove that they are entirely different in their composition. This, however, is accounted for on an other hypothesis: in the softer varieties, the phosphate of lime is so protected by the fat and the animal matter that, under ordinary circumstances, acid can not come in contact with it; but the dense varieties are very soluble, because the acid readily comes in contact with the calcareous portion.

Its origin.—It is a precipitate of the saliva,—or at least the phosphate of lime, and probably the fibrin, comes into the mouth with the saliva; while perhaps the fat and other animal matter are deposited from the mucus. In all cases in which this substance is formed upon the teeth, the saliva has a very definite alkaline character, holding in solution the phosphate of lime, which, by the action of the acid mucus upon the saliva, is precipitated.

Persons of a lymphatic temperament, or a tendency toward it, with muscles of a soft, flabby texture, hair light, teeth of a rather inferior quality, and a free flow of saliva, are most subject to the deposition of tartar; yet there are conditions of almost all constitutions, in which it is freely eliminated. That it is precipitated from the saliva, is a fact so easily demonstrated and so generally admitted, that it need not here be considered.

Points of Deposit.—The points at which it is deposited in the greatest quantities upon the teeth, are in the vicinity of the orifices of the salivary ducts; and hence it is found most abundant on the inner portions of the inferior anterior teeth, and on the buccal surfaces of the superior molars. Frequently, also, it collects in considerable quantities upon the external surfaces of the inferior front teeth. The points upon the teeth to which it most readily attaches, are at the necks, immediately beneath the free margin of the gum, and at the termination of the enamel. A nucleus once formed, and it encroaches upon the crown of the tooth, if no means are employed to prevent its lodgment, at a rate determined by the condition of the saliva.

It is deposited first and most abundantly on the necks of the teeth, because here the saliva first comes in contact with these organs, and here remains for the longest periods and in the largest quantities. That it is precipitated very soon after the saliva enters the mouth, is evident from the fact that it is found collected upon the superior molars, just in the

Steno

vicinity of the orifices of the ducts-of-Wharton, where the saliva cannot be retained for any considerable time, by reason of the position, but must very soon pass along upon the surfaces of the contiguous teeth, on which we generally find it deposited in much smaller quantities. Indeed, this calcareous deposition has been sometimes found in the salivary ducts themselves.

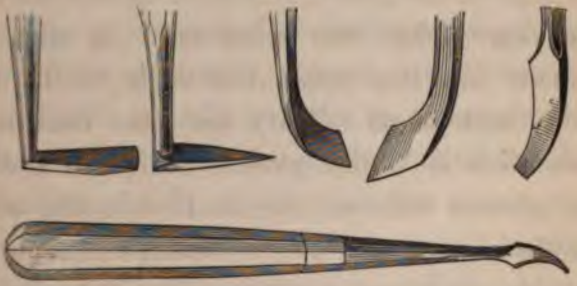
Its Effects.—It exercises no directly injurious influence upon the substance of the teeth; but it is highly prejudicial to the parts immediately in connection with them, upon which they depend for support. It encroaches upon the gums and alveoli, and causes an absorption of these important surroundings; and as they become absorbed, its encroachments are accelerated. In some constitutions this process goes on with little or no annoyance to the patient; while in others, irritation, inflammation, and even suppuration of the gums occur; and thus their destruction is effected in a twofold manner. This irritation and inflammation may extend to the mucous membrane, and involve all the adjacent parts. The dental periosteum, also, if susceptible, as in many cases it is, will become implicated in the difficulty; periostitis will ensue, and often suppuration, thus breaking up the attachments of the teeth even before the surroundings are removed. The alveolus, too, becomes diseased, and in some instances its death and exfoliation result.

Salivary calculus, however, never induces caries of the teeth, nor even favors it. On the contrary, we frequently meet with instances of decay entirely arrested by a deposit of tartar in the cavity.

Persons of all ages are subject to this affection; those past middle life being most so, and those advanced in years sometimes having teeth nearly covered with tartar. There are some constitutions whose diathesis is favorable to a deposition of salivary calculus through life. Others, again, will be perfectly exempt from it till some peculiar constitutional change intervenes, when it will begin to be rapidly eliminated.

Method of removing It.—The removal of salivary calculus is an operation that does not involve a great amount of skill, but, with suitable appliances, is easily performed. There are two methods of effecting it; the one, that of scaling and scraping, and the other, that of decomposing the deposit by the application of an acid. The former is always to be preferred; for, in the latter, the chemical action of the acid does not stop with a decomposition of the deposit, but, by the same affinity, attacks the tooth itself. For the successful accomplishment of the operation, instruments of various forms and curves will be necessary, adapted and adjusted to the various shapes and situations of the surfaces to be operated upon. The most common forms are represented in the following figure. The blade of the instrument should be applied at a slightly obtuse angle with the surface of the tooth, just beyond the edge of

Fig. 1.



the deposit next the gum, and thus slid under the tartar, scaling it off to the point, in such a manner as not to roughen up or abrade the enamel. Deposits of this substance on proximal surfaces of the teeth are to be carefully observed, and removed with instruments of attenuated blades. When the thick incrustations have been thus removed, the surface should then be gently scraped, so as entirely to clean off all remaining portions, and afterward thoroughly polished with fine pumice, or Arkansas- or rotten-stone, and finished by burnishing. During the operation, a frequent employment of the toothbrush with water will be required, to cleanse the mouth of the detached deposits and the increased secretions; and, in general, the completion of the process will occupy more than one sitting. Since this deposit often extends beneath the free margin of the gum, much care is necessar to see that it all be removed.

GREEN TARTAR.

This deposit has been so referred to by writers, a to convey the impression that it is of the sam generic character as salivary calculus. Such a misapprehension is hardly pardonable. The teeth o young persons only are subject to this affection, i being often found on those of children three or four years old. It almost always appears on the labial surfaces of the superior front teeth, and in largest quantity near the margin of the gum. It is seldom seen on the inferior teeth, and only on the anterior surfaces of the superior. The color of this deposit is very dark, inclining to green. Wherever it attaches, the surfaces of the teeth are abraded, and when it is of long standing, the entire enamel beneath it is destroyed, and the dentine is gradually involved in the dissolution. This effect upon the teeth is not produced by the coloring matter observed upon them, but by an acid in combination with this material before it is deposited. The stain is a precipitate from this compound, and the acid, leaving this, combines with the calcareous ingredients of the teeth, to their detriment as above; but the precipitate is entirely innocent.

the teeth, and is easily removed without detriment to their substance; whereas the latter is a thin film, barely sufficient to stain the surface, and yet it enters into the tooth-substance itself, and cannot be removed without detaching some portion of the tooth with it. The one seems rather preventive of caries, which does not occur beneath it; but the other is highly promotive of decay. With these marked features of difference, it is surprising that the two should ever have been confounded, since it is so important that the distinctive character of each be understood, in order to its correct treatment.

Treatment.—In order to a perfect and final remedy for green stain, therapeutic treatment must be combined with the operative; but only the latter will be here described, which has for its object the removal of the deposit, and the rendering of the eroded surface smooth and polished. There are two or three methods of accomplishing this object. When the erosion is but slight, it will be effected with pulverized pumice or Arkansas-stone, applied with water till the stain disappears, and with the subsequent use of the burnisher with a solution of soap. But when the erosion is too extensive to be thus reduced, it must be cut down with a file, and then finished with stone and burnisher, as before. And when the erosion is extreme, a cutting-instrument must precede the file.

IRREGULARITY.

By this term we imply those variations from a beautiful and natural position, in which the teeth are so frequently found. The principal cause of irregularity is a disproportion between the actual size of the arch, and the size required for the accommodation of the teeth. When this disproportion exists, the teeth which are first irrupted, occupy very nearly their proper position; but those which come in afterward, are more or less disarranged, in proportion to the preoccupation of the space. There are cases in which the roots of the temporary teeth are not absorbed, and the permanent teeth are irrupted out of their true position, even when there is room enough for them were the former removed. Irregularity is mainly confined to the front teeth, and consists in either an inward or an outward inclination, and, in some instances, both. Sometimes the incisors are turned round in the socket, so that the edge stands at a very considerable angle with the proper position.

The upper teeth are oftener materially disarranged than the lower, though the latter frequently exhibit some irregularity in front, in consequence of a crowded condition. The teeth most liable to be out of position are the cuspidate. These, of the teeth of replacement, are the last in their irruption; and it often occurs that the arch is previously wellnigh occupied; in which case they are thrown outward. When there is any irregularity of the bicuspids, it is that of an inward inclination. The first and second molars are very seldom out of proper position. The third molars, however, for want of room, are sometimes thrown out toward the cheek, or even prevented from coming out at all in any direction.

Effects.—In all cases, irregularity is favorable to decay. It is even maintained by some that the organic structure of irregular teeth is less perfect than that of regular, because the former are impeded in their irruption, and thus impaired. But this, to say the least, is questionable; for it will be remembered that the crowns of the teeth are formed and completely ossified before they can be affected by a crowded state; and it is hardly probable that they could be materially modified in their structure after this period. The crowns of the teeth are never deformed by a crowded condition. The principal cause of the liability of irregular teeth to decay, is the facility they furnish for the lodgment of foreign substances about them, and the difficulty they present to its removal. And again, in irregular teeth, parts are approximated that nature did not intend should be brought together. Irregularity impairs the speech, impedes the mastication, and often distorts the countenance and deforms the features.

short, thick crowns, and rather yellowish color. The long, thin, white tooth, of imperfect organization and insufficient density, seldom or never presents an atrophied condition.

The Cause.—It may be difficult to point out the precise cause of this affection, but some facts in regard to it are very obvious. There is, in every case, an obstruction in the development of the enamel at the point of defect, and at the time of its origination. In some cases, doubtless, there are a deficient amount and an inferior quality of the material elaborated for the upbuilding of the structure; and this is probably the case when the pits exist at the irruption of the tooth. In other instances, the requisite quantity of material may be elaborated, and yet the vital energy be insufficient to organize it, as in the case of the spots referred to. The latter condition is more frequent than the former, as is evidenced by the more frequent appearance of the spots than of the pits. We are led to infer, then, that the origin of this affection is for the most part constitutional, and not local. There are commonly found traces of it on all the teeth whose enamel was in process of formation at the time of the interruption.

Any general disturbance, such as to interrupt the assimilative process, would be detrimental to the perfect formation of the tooth. Again, some affections may materially affect the organizing power of the nated is common to all the bones; some, however, being more frequently attacked by it than others. It occurs upon the roots of the teeth, but is never developed where there is no periosteum. The manner of its deposit is not uniform; but it is commonly in an enlargement on the point of the root, or from the point some distance toward, and occasionally all the way to, the neck of the tooth. In some cases, it extends entirely round the root, and in others, is confined to one side. It sometimes results in such an enlargement of the root, especially if it is near the point, as to render the tooth very difficult of removal. When it is bulb-form, the entire attachment of the tooth may be broken up, so as to allow this to rotate in the socket, and yet the tooth be very difficult to remove; indeed, in some instances, impossible, without cutting away a portion of the process.

The density of the deposit is usually greater than that of the root on which it is found; though in this respect there is considerable variation: in a few instances we have found it softer than the root proper. The surrounding parts are absorbed for its accommodation. The color of the substance is slightly yellow, not differing much from that of the root itself; and frequently it exhibits a semitranslucent appearance. The rate of its formation varies considerably, sometimes increasing so rapidly as to occasion much difficulty, and at other times seeming to advance very slowly; and frequently it is arrested altogether. Roots are often found affected with exostosis, that have been dead and crownless for a number of years, and yet have never, so far as known, given any trouble because of the affection; and teeth perfectly healthy in other respects may be thus affected.

Its Effects.—It always increases the difficulty of removing the tooth, either by enlargement of the point of the fang, or by deposit upon one side of it, causing it to curve; in which latter case the difficulty is all the greater, from the impossibility of determining the direction of the curve. It sometimes produces a diseased condition of the surrounding parts—in some instances chronic inflammation—that will continue as long as the tooth remains. Nervous affections often result from exostosis, either through irritation caused by pressure on the nerve, or through the diseased condition of the surrounding parts. The floor of the antrum is sometimes absorbed away, in consequence of the enlargement of the point of the fang; and then disease of the lining membrane of that cavity generally ensues.

The Cause.—The cause of this affection is not well understood. It is most probably deposited by the periosteum when this is in an abnormal condition; but what peculiar condition, it is not clearly ascertained, though some have supposed it to be inflammation. It is patent, however, that something more than a state of simple inflammation exists; for there is inflammation in numerous instances without this deposit. Again, in all cases where there is periostitis, that state is definitely indicated by percussion upon the affected tooth; indeed, in the occlusion of the jaws, pain is usually experienced. Yet there are found many teeth whose roots are subjects of this deposit, that have never given any indications, either by pain or otherwise, of a diseased condition.

This subject is one in which there is room, at least so far as dentists are concerned, for extensive observation.

DENUDING.

This consists in a wasting-away of the enamel of the anterior teeth, from the points toward the necks. The affection, however, is of too rare occurrence to demand extended consideration. The color of the enamel is not changed by this process, nor is its natural polish impaired by any abrasion. The dentine, on becoming exposed by this removal of its natural protection or covering, is perfectly smooth, but of a yellowish cast, in some cases inclining to brown. When the enamel is removed, there seems to be a cessation of the destructive process; for the crowns of such teeth will, in many instances, endure for a long time—indeed, till they are worn down by the friction in mastication.

This wasting process usually begins at the points of the teeth, and proceeds toward the necks, on all sides, till the enamel is entirely destroyed. Sometimes, however, it commences on their labial surfaces; this is particularly the case with the superior anterior, but very seldom with the inferior teeth. The affection, however, attacks the inferior more frequently than the superior teeth; yet it is often found assailing both with about equal energy.

The cause of the disease is not well understood, though it is generally conceded to be the operation of an acid contained in the mucus. Doubtless, the agent producing the affection is contained in the mucus; for it usually occurs where there is a large relative amount of this secretion; but that it is an agent of a very decided acid character, we are not prepared to affirm. Decay of the teeth does not seem to progress with greater rapidity while this affection exists, than at other times; and again, the enamel does not present the roughened, abraded appearance we find resulting from the operation of any ordinary agent. With these apparently incongruous facts, it is rather difficult to arrive at a definite conclusion as to the precise manner in which this condition is produced, or the exact character of the agent instrumental in its production.

CHEMICAL ABRASION.

This consists in a gradual destruction of the entire substance of the crown of the tooth—the enamel and the dentine. It is an affection of comparatively rare occurrence. It assails the superior more often than the inferior teeth, though both are subject to it. It begins upon the points of the central incisors, wasting them away most rapidly at the median line, from which it progresses each way, involving the lateral incisors, cuspids, and sometimes the bicuspids, so that a curved line is presented by the edges of the teeth, of greater or less inclination, according to the rapidity of the process. When the superior teeth only are affected, the opening between the ends of the upper and of the lower front teeth, when closed, is a semi-ellipsis. If the inferior teeth are affected, as is sometimes the case, then the opening will be an ellipsis.

In the case of Mr. G., the affection had been in process about two years and a half; the wasting-away extended to the first bicuspids both above and below; and when the jaws were closed, the ends of the upper and of the lower central teeth were about one third of an inch asunder, and the opening was of the elliptical form. It was a mystery to him. Two years and a half before, his anterior teeth shut close together on the ends. He had not used them in the mastication of his food, for his molar teeth were all good, and sufficient for this purpose; and moreover it had been impossible for him to use them in mastication, since he could not bring them together; and he had not been in the habit of putting any hard substance between them.

The Cause.—The cause of this affection, like that of denuding, is not well understood. It is supposed, however, to be induced by an acid contained in the mucus. If this supposition is correct, it must be some acid with whose nature we are but little, if at all, acquainted; or, if any ordinary acid, it certainly must be modified by very peculiar circumstances. The surface upon which it acts is always perfectly smooth and polished, never presenting that roughened and abraded appearance caused by the action of any ordinary acid upon enamel or dentine. And again, if this affection results from the operation of an acid in the mucus, why does not this acid, to some extent at least, affect the teeth at other points? Such is not the fact; and caries that has previously commenced at other points on the teeth, does not progress more rapidly during the existence of this disease, than before; but it certainly would, if there were a large quantity of acid in the mucus.

It has been supposed that the mucous follicles of that part of the tongue which comes in contact with the teeth at the affected part, are the agents that produce the disease. Of this, however, there is not evidence sufficient to warrant an adoption of the theory. The cupping of the molars and cuspid bears strong indications of being an analogous process, and yet no such influence can exist for its accomplishment. We have no theory on this subjec to present, regarding it as still an open field for investigation. There can be little doubt, however, that the cause of denuding, of chemical abrasion, and of cupping, has its origin in the constitution, is not merely local, and may be removed, and the affection arrested, by constitutional treatment.

NECROSIS OF THE TEETH.

By this term is understood the death of the part affected. It has been remarked that the condition is similar to mortification in the soft parts of the system. But in the latter there occurs a change of structure; whereas, in the bones, and particularly in the teeth, there is not necessarily any change consequent on the loss of vitality. The teeth have their organic connection with the surrounding parts by the external and the internal periosteum and the pulp; their crowns depend for vitality upon the internal organism; and when this is destroyed, they are wholly necrosed, or deprived of vitality, as is evident from the total loss of sensibility in them immediately after the destruction of the pulp.

crosis, especially the partial form of it to which reference is made above. Protracted fever, or diseases of any kind that diminish the vitality of the constitution, will in a corresponding degree diminish that of the teeth, and sometimes destroy it entirely. Excessive medication, especially with mercurials, will sometimes produce partial, and occasionally total necrosis, as will also sometimes blows or violent shocks, when these are not sufficient to displace the teeth. Great and sudden changes of temperature have been reckoned causes of this affection; but it may well be doubted whether they are adequate, without the concurrence of other influences.

CHAPTER II.

CARIES OF THE TEETH.

NOTWITHSTANDING the teeth are so important in the human economy, having functions so various and so extensive to perform, they are greatly neglected in most instances, and, in many subjected to positive violence; as, for example, in crushing or biting hard substances, sustaining weights, and suffering severe percussion, sudden extremes of temperature, bungling dental operations, etc. Very few give that attention to these organs, which is requisite to preserve them from injurious influences; and, owing to artificial modes of life, and consequent impairment of health, this is often difficult to do. Indeed, these influences are frequently not known, and the causes of disease in the teeth not explored.

Such is the truth, to some extent, in regard to caries; though this affection is more generally a result of conditions well understood. The dentine is affected more frequently by caries than by any other form of disease. It is both frequent in occurrence and fatal in tendency. Scarcely any that have attained maturity, are exempt from its ravages. It is a disease which the resisting forces can but feebly withstand, and in which the recuperative powers are of no avail. Some maintain that softened dentine does in many cases regain its normal density; but this cannot be, unless it retains its vitality. But any agent possessed of sufficient energy to decompose the dentine, will destroy its vitality. What is that decomposition? Either a lack of vital power to maintain the integrity of the organic structure, or the action of some agent having an affinity for a certain part of the dentine more potent than that vital power. In either case, the vitality is destroyed. In an organized structure, removal of one of its component parts occasions a loss of vitality in the rest.

Caries makes its first attack upon the dentine, and progresses most rapidly in the direction of the tubuli. There are variations from this course; as, for example, in the large superficial caries on the labial surfaces of the superior incisors. In many cases, too, it advances immediately beneath the enamel. Portions of the dentine imperfectly protected by the enamel, on account either of an injured condition or of an imperfect formation of the latter, are liable to be attacked by this disease; and points that, by their location or any other unfavorable circumstance, retain injurious agents in contact with the tooth, are very subject to decay.

The attack and progress of caries are modified by the constitution of the teeth. These may be defective either originally or accidentally. Original defectiveness would extend to all the teeth of the same individual, whilst accidental might exist only as to some of the teeth in the same mouth, and these only at particular points. Such conditions are peculiarly favorable for the attack of caries. When the whole crown of the tooth is imperfectly organized, the decay will advance with uniform rapidity, till the whole is destroyed. But when it is only portions of the tooth, the caries, after a time, becomes retarded in its progress, and in some cases checked altogether.

Among the circumstances which modify the progress of this disease, are, a change of the condition or character of the agencies producing it, and an increase or a diminution of the amount of such agencies. The progress of caries will also be governed somewhat by the age of the person whose teeth it attacks, and by the peculiar constitution of the organs themselves; for, in regard to constitution, these present an almost infinite variety, the relative proportions of their constituents being exceedingly various, even in persons of the same age, and continually varying in the same person at different ages. There is a constant change going on, the calcareous elements increasing, and the animal decreasing. But a proper relative amount of elements may be elaborated, and yet a defective organization exist. This condition arises from impotency of the organizing power, or from a failure of the materials to arrange and combine; and it is dependent entirely on accidental causes. In vital energy, indeed, the teeth exhibit great diversity; and this corresponds with, and to some extent depends upon, the vital energy of the general constitution. Dead dentine is decomposed more readily than living; and hence the conclusion that vitality resists caries, and that this resistance corresponds with the vigor of the vitality.

The points most frequently attacked by caries, are the proximal surfaces of the teeth, the indentations and fissures on the masticating surfaces of the molars and bicuspids, the longitudinal depressions on the buccal and palatal walls of the molars, and the necks of the teeth at the termination of the enamel. On the proximal surfaces, the enamel is thinner than elsewhere; and the situation is peculiarly favorable for the accumulation and retention of injurious agencies. The union of the enamel in the fissures and indentations of the crowns of the molars, is often imperfect; and thus there is a way of entrance for vitiated fluids to the dentine. Decay is found at the terminations or intersections of these fissures earlier than at any intermediate points. The indentations, or grooves, on the sides of the teeth, are usually attacked by caries at that point next to the neck. Less frequently, the disorder is exhibited at the neck, just beneath the border of the enamel, under which it burrows with a transverse extension.

The order in which the elements are removed, is governed by the nature of the agency which effects the decomposition; and this is usually one having an affinity for the calcareous elements strong enough to destroy the texture of the dentine, and remove the earthy portion. Those acids which have an affinity for the lime of the dentine, produce its decomposition in this manner. When the decay is thus caused, the portion remaining in the cavity is soft, and approximates the gelatinous condition as the calcareous material is abstracted. Agents of a different character, too, often produce decay. Alkalies will act upon the animal portion of the dentine, and remove it; and in caries thus produced, the residue is friable and chalklike. In other cases the constituents are simultaneously removed. Nitric acid will cause an entire breaking-up of both the earthy and the animal constituents. Death of the dentine generally induces decay, decomposition being more easy after the vitality is lost. But there are exceptions to this.

The dentine outside of the decay may be in an inflamed and irritable condition, so that contact with the decayed portion will produce pain; and thus we may be led falsely to conclude that the softened dentine is sensitive; and, indeed, it is maintained that in some cases the partially decomposed dentine is so, on the supposition that a small portion of the calcareous elements may be removed, and yet the filaments of the nerve ramifying the part, not be destroyed.

The progress of caries is far more rapid in the crowns of the teeth than in the roots, for the reason that the former are more exposed to the influences of external injuries. It is true that the crowns are covered by enamel, which is designed to shield the dentine from injury, but which is often defective, and on which are accumulated agencies that it cannot resist, even when it is perfect; so that the enamel itself is sometimes decomposed. The roots, too, possess a higher degree of vitality than the crowns, and their ability to resist the encroachments of decay is correspondingly greater; and hence we often find the roots of teeth solid and free from decay, the crowns of which have been removed by rapid decomposition. Injurious substances are sometimes pressed into contact with the dentine, through defects in the enamel, or under its projections, and there retained till their mischievous effect is produced.

It is maintained by some writers that caries is contagious. Dr. Koecker was of this opinion. The question, then, is, whether there is any property in the decayed dentine of one tooth, capable of producing the same condition in the healthy dentine of an other.

The residue of abnormal dentine in the soft decay, consists of the animal elements and a small portion of earthy material; and in decay in which the gelatinous constituent is abstracted, the remainder is chalklike, consisting mainly of phosphate of lime. In neither of these is there anything that can possibly operate on the healthy dentine. There is one thing here, however, that is worthy of remark, and that has perhaps led to the mistaken notion that caries is contagious: decayed dentine will absorb and retain fluids that injuriously affect sound dentine; and when the decay is on the proximal portion, two teeth are subject to the same exciting cause. But it is seldom that two teeth thus situated are both in the same stage of decay; a fact principally attributable to the difference in their constitution. The decay of the teeth in pairs has also been adduced as evidence of the contagious character of the disease. This, however, results from the fact that the pairs are formed at the same time; are subject to the same influences in their formation, and hence are constituted alike; and if one of the pair is defective, the other will be in a like condition. When there is a vitiation of the saliva or mucus, they will be similarly affected. In no common acceptation of the term contagious, can it be applied to caries of the teeth.

The color of caries is exceedingly various, from that of healthy dentine, through every intermediate shade, to jet black. The rate of the progress is indicated by the color of the decay, being slower as this is darker, so that when the decay becomes almost stationary, the affected portion is black. The degrees of color are differently enumerated by different writers; as, by Koecker five, by others seven, and so on. Three, however, are sufficient for our purpose: white, brown, and black. The sensitiveness of the dentine is greatest in teeth affected by the white decay, and usually decreases as the color darkens; though there are exceptions to this rule; for occasionally we find teeth affected by dark decay, that are quite sensitive. The light-colored decay is more difficult to arrest than the dark. In many cases of the former, filling seems hardly to retard its progress; whereas, in the latter, by proper filling, the advance of the decay may be checked altogether. The cause of the dark color of caries is not perfectly comprehended. It is doubtless a deposit upon the decayed part, and is most probably a metallic oxyd, as iron, sodium, potassium, and calcium are found in the saliva and mucus in several combinations.

The opinion is entertained by some, that this deposit protects the dentine from the influence of injurious agents. But this is most probably not correct, at least to any perceivable extent. If the deposit does thus serve as a protection, the removal of the discolored portion would subject the dentine to a renewed attack of caries, which experience assures us it does not do, but that after some time it assumes the dark hue again. Those who maintain this opinion, refer, in support of it, to the fact that a deposit of oxyd of silver being made upon a decay of light color, by the use of nitrate of silver, the progress of the decay is thereby retarded. This retardal, however, is effected more probably by a change in the character of the decay, than by any protection afforded by the coating of oxyd of silver.

Some sensitiveness commonly accompanies caries. It does not often amount to pain, but is rather a sense of uneasiness; yet, when anything is brought in contact with the sensitive dentine, as sudden changes of temperature, acids, etc., intense pain may be produced. Dr. Koecker remarks that caries is most tender in its first stages; and Dr. Cone, that when a tooth is attacked by it, the sensitiveness is increased. The surface of the dentine, or that part united to the enamel, is susceptible of the most acute sensitiveness, since here is the place of termination of the nerve-fibrils which ramify the dentine, and which, whether in a healthy or a diseased state, are more sensitive at their terminations than along their extent. When there is inflammation of the dentine, intense pain may be produced by the contact of an instrument, in a cavity of decay, at the line of union

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of the dentine with the enamel, and very little se tiveness be present elsewhere in the cavity. Se tiveness of a uniform character sometimes perva all parts of the cavity, while at other times it m be very intense at one point, and very slight entirely absent at any other. A thin lamina of t dentine lining the whole cavity, may be uniform sensitive, and in some cases this sensitiveness ma involve the entire body of the dentine.

By means of this sensitiveness, warning is transmitted to the pulp, which emits osseous material with increased energy; and thus a process of filling up the natural cavity of the tooth is instituted, that the decay may not encroach upon the nerve. But this warning may, in some degree, be transmitted to the pulp, though there be no increase of sensitiveness.

This sensitiveness is modified by the character of the teeth, the nature of the decay, and the state of the patient's constitution. The teeth of the same person will be more sensitive at one time than at another, because of a greater irritability of the nervous system. Those teeth which decay most rapidly, are usually most sensitive; though in teeth whose vitality is lost considerably in advance of their decay, there is no sensitiveness at all. Except in such cases as last mentioned, the whitest and most rapid decay has most sensitiveness, the brown much less, and the black scarcely any.

liarities of the mother, and in others, those of the father; while sometimes they participate those of both parents; and when the parental imprint is thus found stamped on the teeth, it will also be found that those of the same class decay at the same point and at about the same age as in the ancestor. In such cases the defect is manifestly hereditary; it cannot be accidental: the coincidences thus constantly occurring preclude any other conclusion. Hereditary taint, then, may be regarded as a predisposing cause of caries.

Impaired vitality is another predisposing cause; and not only impaired vitality of the teeth and contiguous parts, but also that of the general system. Indeed, the vital vigor of the teeth depends upon that of the general system, and, when there is no local influence at work, corresponds with it; so that when the general system is in the most healthy condition, the teeth possess the greatest power of resistance to deleterious agencies. This resisting power is, at best, comparatively feeble; but its feebleness is, to some extent, compensated by the peculiar structure of the teeth, which is less liable to decomposition than any other part of the human body. Yet the integrity of these organs depends much on the maintenance of a healthy vitality, and this on that of the general system. A dead tooth will decay far more rapidly than a living one in similar circumstances;

and hence the conclusion that vitality resists injurious agents, and that the resistance will be proportionate to the vitality.

All febrile conditions promote and facilitate decay, and frequently in two ways: by diminishing the general vitality, and by changing the secretions of the mouth so that these act injuriously upon the teeth. Accompanying such conditions, there is generally inflammation of the dentine; and in such cases, this always partakes of the general disorder so as to become very susceptible to injury. All diseases, indeed, that impair the vitality and change the secretions, may be considered predisposing causes of decay, and some even more; dyspepsia, for instance, being not only predisposing, but also exciting, since it prepares in the stomach an acid that is almost continually thrown upon the teeth, and that acts upon them with great energy. Residence in miasmatic regions, is also a predisposing cause, inducing unfavorable conditions.

Diminished vitality may result either from constitutional or from local causes. These latter are such as produce an irritable or diseased condition of the immediate parts, or an abnormal condition of the dentine, without the power to effect its decomposition. Local causes of a diminution of vitality are not in their character so formidable, and not so difficult to control, as those which are constitutional.

Many medicinal agents are regarded as predisposing causes of caries; and among these, mercurials occupy a prominent place. They operate by vitiating the secretions of the mouth, and producing an abnormal condition of the periosteum about the fangs of teeth, the mucous follicles, and the salivary glands. Some entertain the opinion that the abnormal action of the absorbents, induced by mercurials, predisposes to decay.

Dental operations performed at an improper time and in an improper manner, may be reckoned among the predisposing causes of caries. The vitality of the teeth may be thus impaired, or a diseased condition established, or the part operated upon may be permitted to remain rough, so that foreign substances will be retained, and, becoming vitiated, produce a deleterious effect. Often, from an improper use of the file, extensive inflammation of the dentine supervenes, which is sometimes followed by death of the tooth, and by disease of the contiguous parts. Artificial substitutes imperfectly adapted, are, in many instances, the occasion of caries; not that clasps or the edges of the plate tend directly to injure the tooth, but the agencies superinduced by them do, and especially when the material used is not of the right quality.

Lack of proper exercise in mastication induces a condition that is favorable to decay. It does so, however, rather by favoring injurious agents to act on the teeth, than by imparting any direct predisposition to the teeth themselves. Substances of all kinds are deposited much more rapidly when the teeth are idle.

The teeth cannot, with impunity, undergo sudden transitions from one extreme of temperature to another, or even such extremes as may be endured by the surrounding parts. By these, inflammation of the dentine may be induced, and the vitality of the teeth diminished, so that, even in friable teeth, checking of the enamel will occur, and thus a condition arise that will facilitate decay.

EXCITING CAUSES OF CARIES.

When there is a predisposition to caries, any of the exciting causes act with more vigor. Teeth that are well constituted, and that have retained unimpaired health and vitality, withstand influences that, in less favorable circumstances, destroy them in a very short time. The immediate cause of decay is the action of agents chemically upon the teeth. It is not here proposed to enter upon an investigation of the manner in which these various agents operate; for that would open up a vast field for exploration—a field outside of the province of this work. The sources of these agents, however, are several: as, vitiated secre-

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tions of the mouth, the saliva, and the mucus; abnormal secretion from the stomach; decomposition of animal and vegetable substances in the mouth; acids taken with food, or administered as medicines; and galvanic action.

Sometimes the secretions of the mouth are wholly acid, and thus these natural products, so vitiated, become instruments of mischief. The natural state of the mucus is acid, but that of the saliva alkaline; so that these secretions counteract each other; but when the saliva and the mucus are both acid, the teeth must suffer. These secretions may become vitiated, through inability of the glands, from disease or an enfeebled condition, perfectly to perform their functions; or the blood may be in an abnormal state, and the glands unable, on that account, though they were healthy, as they seldom are in such case, to elaborate healthy saliva: when the fountain is corrupt, the stream cannot be pure. Thus, anything that produces a diseased condition of the blood, tends to the decay of the teeth; and such diseased condition often has a direct injurious effect on the secretive apparatus, and so works a double harm.

But to the theory of the pernicious influence of the saliva, it may be objected, that, if it were true, all parts of the teeth would be alike affected. This objection, however, will lose its force when it is considered that the teeth, in many cases, are not equally well organized in all their parts; that some parts are not so well protected as others; and that between the teeth there is room for the retention of saliva and foreign substances, which there combine their influence upon them. In cases in which there is a great quantity of viscid saliva constantly flowing, the teeth decay very rapidly. The decay is of a light color; so light, indeed, that, in many instances, it is difficult to distinguish it, by this, from undecomposed dentine.

The gastric fluid often becomes deranged by irritation or disease of the stomach, so that the function of the latter is very imperfectly performed, and fermentation of the food occurs, evolving agents that injuriously affect the teeth. In dyspepsia, such agents are often brought in contact with the teeth by eructation and vomiting; and the diseased gastric fluid, which contains a large proportion of hydrochloric acid, is also thus brought in contact with them, acting upon them with great violence. After food commingled with this secretion is ejected from the stomach, the teeth will be found eroded over all their surfaces. Dyspeptics will appreciate this remark. In such cases, if the teeth are not of superior organization, they are destroyed in a short time. Their surfaces thus roughened, afford a lodgment for foreign substances on all parts.

The most common agents, however, that injure the teeth, are originated in the mouth, by the decomposition of animal and vegetable matter. By this process, elements are eliminated, that form new combinations, and these operate as refined instruments in the destruction of the teeth. Favorable conditions exist in the mouth for such decomposition, and also for such new combinations; for there is a sufficient amount of heat and moisture; and both of these, especially the former, facilitate the action of any acid upon the dentine. The character of the saliva and mucus will very much modify the decomposition of foreign substances in the mouth. If these secretions are both acid, the decomposition will be much more rapid, and more potent in its effect.

Again, it is sometimes the case that the salivary glands are comparatively inactive, except when specially excited, and yet the mucous glands still efficient, eliminating their secretion; so that the mouth assumes an acid condition, because there is not saliva sufficient to neutralize the mucus; in which condition decomposition of foreign substances would be greatly accelerated. There are many cases, however, in which the flow of saliva is copious, and yet the decay very rapid; which is in consequence of an acid condition of both secretions, or of a rapid decomposition of foreign substances in the mouth.

There are acids taken with the food that act directly upon the teeth; as acetic acid, or vinegar. Professor Westcot says: "Acetic and citric acids so corroded the enamel in fortyeight hours, that much of it was easily removed with the fingernail." And "Malic acid, or the acid of apples, in its concentrated state, also acts promptly upon the teeth." Now, these acids, in the use of many kinds of food, are brought into frequent contact with the teeth. In the manufacture of vinegar, sulphuric acid is often employed; so that in this article of food we have that acid either alone or combined with the acetic, the former acting with greater energy upon the teeth than the latter. Acetic acid also facilitates the decomposition of food retained in the mouth, and thus reproduces itself in abundance.

After eating apples that contain a great amount of malic acid, the teeth will be found corroded over all their surfaces. This acid, as well as the others, affects the enamel somewhat, and when the latter is very thin, though it may not be all removed from any particular point, yet its integrity will be destroyed, so as to be readily fractured, thus admitting injurious agents in contact with the dentine, which is much more susceptible of injury from acids than the enamel: points imperfectly protected by this are violently attacked by acetic, malic, and sulphuric acids. In decayed cavities these agents produce rapid results. They should be as much as possible avoided, and, when necessarily used, should be removed from the teeth by cleaning with great care. It would be safest to employ some neutralizing agent after the use of any acids with food. During mastication, there is an increased secretion of saliva, which, if in a healthy state, will tend to neutralize any acid that may at the time be present, and also, by its flow, to remove foreign substances from the mouth.

Salts may be decomposed in the mouth, and their acids act upon the teeth; as when the acid of the salt has a stronger affinity for any element of the tooth-bone than for the base with which it is combined. Many medical preparations contain agents peculiarly deleterious to the teeth; acids being especially in requisition for these, and not in homeopathic dilutions, either. The acids most commonly thus administered are the hydrochloric, the nitric, the sulphuric, the acetic, the tartaric, and the citric, any one of which will produce direct and rapid decomposition of the dentine, even when unaided by the temperature of the mouth. These acids are often administered by physicians, without any regard to their nature or their influence upon the teeth. Sometimes, however, they are given through a tube; though this method generally does not amount to much as a precautionary measure, for in most instances the fluid comes in contact with all parts of the mouth. A subsequent rinsing of the mouth with water effects only a dilution, not an entire removal of the acid. In order wholly to counteract their injurious influence upon the teeth, an alkaline solution should be used after the administration of such medicines.

Galvanic action is a cause of decay of the teeth, only so far as it is a means of decomposing compounds which are in the mouth, and the elements of which, according to the laws of affinity, form other compounds, some of which are highly prejudicial to the teeth. The elements hydrogen, nitrogen, and oxygen, may thus be set free from animal and vegetable substances, when they will at once seek other elements with which to combine; and the character of the combinations will be determined by the nature of the elements, and by the attendant circumstances. These compounds will frequently be of an acid character.

Such an arrangement may exist as will maintain a constant galvanic action, whose legitimate effects will be as constant upon the teeth; and this ceaseless process cannot but make its mark. It is a favorable arrangement for galvanic action when there are two or three kinds of metals in the mouth at once, particularly if these are such as differ in their affinities for oxygen. In some cases three or four kinds of metals are employed in filling teeth of the same mouth; in some, fillings of one metal and a plate of another; and in others, plates of so few carats are used that they oxydize rapidly in the mouth, without the aid of any other metal.

COMPARATIVE LIABILITY TO DECAY.

All classes of teeth are not alike liable to decay. Their difference in this respect may arise from a dissimilarity in their organic structure, the best organized being the most capable of resisting disease; or from a concentration of the destructive agency upon the tooth first affected. The first molars are much more liable to decay than any other teeth, since they are less perfectly developed than those formed at a later period of life. They are the first permanent teeth irrupted, and are subjected to all the irritating conditions consequent on the removal of the temporary, and the irruption of the other permanent teeth. But these conditions, in many cases, produce no apparent injury upon them, they maintaining their integrity till all the other permanent teeth are irrupted, and then decaying earlier than any others. In such cases, the decay is a result of influences more efficient than those occurring on the irruption of the other teeth.

After the first, the second molars are most subject to caries; and after these the second bicuspids. The latter two classes doubtless are so subject, more from the facility they afford to the lodgment of deleterious substances, than from a relatively imperfect organization. Besides, from six to fifteen years of age, the teeth are less appreciated and less cared for than at a later period of life. The next most liable to decay are the third molars. Then follow in order the first bicuspids, the lateral incisors, the central incisors, and the cuspids. Below are appended, in tabular form, one thousand cases of decayed teeth, as observed under ordinary circumstances, exhibiting the number and per cent. of these in each class :—

26, or	2½	per cent.,	in central incisors.
38, or	3⅔	"	in lateral incisors.
24, or	2¼	"	in canines.
87, or	8⅔	"	in first bicuspids.
134, or	13⅓	"	in second bicuspids.
370, or	37	"	in first molars.
218, or	22⅖	"	in second molars.
102, or	10⅛	"	in third molars.

Of these, a large proportion were removed for relief from disease originating in caries of the dental tissue. In general, the superior teeth are liable to decay earlier and more rapidly than the inferior.

CONSEQUENCES OF CARIES.

It is here proposed to refer only to some of the more common results of this affection, one of the most obvious of which is the exposure of the pulp of the tooth; on which exposure, disease ensues, and

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finally death. During this diseased condition of the pulp, there occurs that very peculiar sensation commonly denominated toothache. As well as the destruction of the pulp, the entire destruction of the crown of the tooth is the inevitable consequence of caries, unless this is interrupted in its progress. After the destruction of the pulp and the lining membrane, the external periosteum in many cases becomes involved, the affection being but an extension of that which destroyed the internal periosteum. Inflammation and suppuration are of common occurrence, by which a discharge is established from between the margin of the gum and the neck of the tooth, or through a fistulous opening in the process and the gum, as is the case when an abscess is formed at the point of a root.

A diseased condition of the alveolar process is, in many instances, produced by diseased and dead teeth; necrosis and an exfoliation of considerable portions being sometimes the effect. Indeed, extensive caries of the jaw is occasionally thus produced. Disease of the antrum, too, is very generally induced or greatly aggravated by the same cause. Tumors, sometimes of a malignant character, connected either with the bony or with the soft parts, not unfrequently spring from this source, particularly in constitutions of a cancerous diathesis. Great nervous derangement may result, either in whole or in part, from decayed teeth, as does very frequently facial neuralgia, which is sometimes confined to a single nerve-branch in the immediate vicinity of the irritating cause, sometimes ramified over the whole side of the face and head, and occasionally spread much farther, so as even to implicate the shoulder and the arm. Neuralgia of these, extending down to the hand, is often found to be instantly relieved by extraction of a diseased tooth; and any operator of much observation can call to mind numerous instances in which facial neuralgia has been thus relieved or wholly cured. This affection of the face, however, does not always originate in diseased teeth; though there is little doubt that, in a majority of cases, it rises wholly or partially from this cause.

Inflammation of the mucous membrane of the mouth, is a common result of diseased teeth; and it is liable to extend to distant parts of this membrane, and occasion greater difficulty than in the mouth, as would especially be the case when there is an irritable condition of the throat and bronchia; and the esophagus and stomach would not be exempt. In what degree such an implication of the respiratory and the digestive apparatus is referable to diseased teeth, it may not be easy to determine; but it is impossible that a number of such teeth, involving in their disease all the ramifications of the facial nerves and the whole mucous membrane of the mouth, could remain there with impunity. And besides this direct influence on the lungs and stomach, diseased teeth are constantly emitting offensive odors, which are taken in by inhalation, and offensive matter, which is swallowed with the food.

TREATMENT OF CARIES.

In the rational treatment of caries, the first considerations are the nature and peculiarities of the obvious predisposing causes; whether these are constitutional or local; and if constitutional, whether they are such as can be modified by therapeutic treatment of the general system. If the latter, such treatment should be adopted as will bring about the most perfect state of health, so as to obviate as far as possible all conditions favorable to decay, by securing a healthy state of the mouth in all its parts—as the gums, the mucous membrane, the salivary glands. The teeth should be kept free from all deposits and accumulations of whatever character; for, though some of these may not affect the teeth directly, yet they induce disease of the surrounding parts, and thus indirectly exert a pernicious influence upon them.

The foregoing remarks, however, refer rather to the prevention of decay than to its treatment after it actually exists. Yet they are, on that account, none the less important, since here, as elsewhere, prevention is better than remedy. But they apply to such prevention as well after decay has commenced as before, if the ultimate object is a preservation of the teeth. After the first attack, the teeth are always more vulnerable, and less capable of resistance.

When decay has attacked a tooth, the treatment depends upon the nature and extent of the disease. Rapid decay requires more prompt and energetic treatment than that of slow progress. Remedies that would be appropriate and efficient in the one, would be quite inapplicable to the other. The persistence of caries is not always in proportion to its rate of progress. We sometimes find teeth in which the decay is not advancing rapidly, and thence are led to conclude that it may be easily arrested; the affected part, if superficial, is removed, and the dentine finely polished; and yet, after a time, decay again attacks the tooth at the same point. Or, where the caries has penetrated the tooth, so that it requires filling, though it is skillfully filled, and the plug and tooth carefully polished, yet in many instances the dentine soon softens about the border of the plug.

The extent of the decay will suggest the mode of treatment. Superficial caries on some parts of the teeth may be remedied and removed by cutting away the portion implicated in the disease, dressing with a fine file, polishing with Arkansas, Scotch, or rotten stone till the filemarks disappear, and then applying the burnisher very thoroughly to the entire surface operated upon. Afterward, the most careful attention to cleanliness is requisite, to prevent a recurrence of the attack. This treatment is applicable to decay upon proximal surfaces; but in the depressions of the masticatory or buccal surfaces of the molars, and on the labial surfaces of the front teeth, it can not be employed.

Sometimes the dentine, at points where it is exposed, gives warning, by acute sensitiveness, of threatened decomposition, before there are any other indications of it, thus evidencing the presence of some very irritating agency promotive of decay. Such points should receive prompt and strict attention, and the increased sensitiveness be immediately subdued; as it may be, by the use of some preparation that will counteract the exciting influence—some dentifrice or lotion containing an alkali; or a rubbing of the sensitive surface with a smooth steel burnisher, will in many cases effect this object, and prevent the development of decay.

It has been suggested that the character of the caries may be modified by the local application of therapeutic agents—that the rapid decay may be changed to the slow—and this, too, without regard to the attendant circumstances, such as the condition of the secretions of the mouth, the causes producing the disease, etc.; and various such agents have been proposed. It is held that by an application of the nitrate of silver, the white, rapid decay being changed to that of a dark color, becomes of less rapid progress. But there is no very palpable principle on which this agent can be supposed to operate to arrest caries. It is generally conceded to be injurious to a healthy tooth; how, then, it becomes beneficial to one decayed, it is not easy to perceive. The notion may have originated in the fact that, after the application of nitrate of silver, the cavity turns dark, or black; and this color being naturally associated with the slow form of decay, it may have been concluded that it might be thus associated by artificial means. This conclusion, however, is fallacious; for the coloring matter being the oxyd of silver deposited on the walls of the cavity, is wholly foreign, and holds no necessary relation to the kind of decay, or to the agency producing it. The deposit may possibly serve as a temporary shield to the dentine beneath, but only temporary; whereas, on the other hand, it will be remembered that nitric acid is liberated by the decomposition of the nitrate, and operates destructively upon the tooth-bone. An ethereal solution of the terchlorid of gold has also been suggested as a preventive application. Its operation would be much the same as that of the nitrate of silver, and equally inefficient. Preparations to neutralize and counteract the effects of deleterious agents upon the teeth have been recommended as topical applications. These are such as possess alkaline properties. But anything of this kind would require frequent application; indeed, it would be necessary to keep the affected part constantly under its influence, as long as the surrounding conditions continued to favor decay.

Though nothing of this kind can be relied upon permanently to arrest caries, yet, in many instances, much benefit is to be derived from local treatment. Alkaline topical applications will, in many cases, alleviate the most acute sensitiveness of the dentine; accomplishing this, no doubt, by their neutralizing influence upon the irritating agents. Many operators employ simply the bicarbonate of soda for this purpose, with the happiest results. As an other class of topical applications to check or modify caries, those have been suggested, which will form an insoluble compound with the gelatinous or animal portion of the tooth; such as tannin and some of the essential oils. The only effect of these, however, is, to form a shield or protection over the structure beneath: there is, of course, no change effected in the conditions or agencies which produce the decay.

CHAPTER III.

GENERAL REMARKS ON FILLING.

THE importance and value of the operation of filling are obvious, from various considerations. It is one that is in frequent requisition. It is the only treatment for deepseated caries: by it, the disease is arrested and the lost part restored, so far, at least, as it can be by a foreign substance. There is no material similar to that destroyed—no substance possessing the characteristics of the lost portion of the tooth—with which to effect the restoration. Under favorable circumstances, the operation of filling is efficient in arresting caries and restoring the lost portion of the tooth. In order, however, that it be permanent in its character, the case needs to be attended with favorable conditions, and the work to be thoroughly done. But, two similar operations, both equally well performed, may result very differently as to ultimate success in preserving the teeth to which they may have been applied; the one effectually preventing further decay, and the other seeming to interpose to it but little obstacle. Indeed, the probabilities of such success in different operations, equally well accomplished, cannot be calculated, without considering a variety of circumstances, such as differences in constitutions, in states of health, in previous and subsequent habits.

The filling of the teeth is predicated upon the nature of decay, upon the fact that the lost portion will not be restored by nature, and upon the fact that caries is an effect of external causes, and not of any cause within the tooth itself. If the cause of caries were alone within the tooth itself, then filling would not be its rational treatment. The organic structure of the teeth is of such nature that no change will take place in it, independently of external influences. Any organ possessing sufficient vitality and circulation to be susceptible of disease and decomposition, independently of external influences, possesses recuperative power enough to restore to itself a lost part; and if dentine could be decomposed without external agents, the introduction of any foreign substance whatever into the cavity, would certainly not arrest the decay, but most probably would accelerate it. If it is true that decay of the teeth ever originates in constitutional causes, then the treatment should be constitutional, and not local.

The filling of teeth, then, is based upon the inability even of healthy dentine to resist the encroachment of decay. As preliminary to the operation, all the circumstances, both direct and collateral, should be carefully noted in every case, and the course of treatment should conform to the indications thus observed. The constitution, temperament, and health of the patient; the peculiarities of the teeth; their susceptibility of decay; their present condition, and that of the parts about them; the periosteum, the gums, the mucous membrane, the secretions of the mouth, the saliva, and the mucus, should all be closely considered; for only on a correct diagnosis can a proper treatment be based. Every operation should be performed as completely as, under the circumstances, is possible. Indeed, every step in the operation should be perfect, before a successive one is attempted. All the instruments employed should be unexceptionable in material, form, and condition; inferior instruments should find no place in the case of the dental operator. The material for filling should be of the best quality, and prepared in the best possible manner. Not that material for filling should be prepared in only one way; for some materials, gold for instance, may be prepared in three or four different forms, each perfect in its kind, and efficient in the hands of the expert manipulator. While with instruments and material all in the most perfect condition, and with a thorough cognizance and appreciation of all the attendant circumstances, our most skilful operators barely attain success, need we be astonished that the man ignorant of all these circumstances, and possessed of only a few crude, ill-conditioned instruments and materials, the nature of which he does not understand, fails in almost every essay?

Much depends on therapeutic treatment; not, indeed, to restore parts already lost, or to restore to health parts much diseased, but to avert a tendency to disease in parts but feebly organized. This treatment may be either constitutional or local, or both; but constitutional when there is indicated any idiosyncrasy favorable to decay. If, however, the whole difficulty is local, topical treatment only is required. What the special treatment should be in either case will be more fully considered hereafter. Comparatively little can be accomplished by local application to the substance of the tooth; but the parts contiguous, as the gums and the mucous membrane, may be thus treated, with an assurance of more signal results.

Though in the teeth nature does not assist to restore a lost portion, as in those parts more highly organized, yet, to compensate in some degree, the destructive process is far less rapid in the former than in the latter. The general surgeon depends much upon nature for the success of his operations; for, though he perform them unskilfully, yet the kind energy of nature is always present to assist him; but in this specialty the practitioner must necessarily depend more upon his skill, and less upon the curative efforts of nature.

MATERIALS FOR FILLING.

In the selection of materials for filling teeth, there are some important considerations that should be kept constantly in view; the first and principal of which is to choose that kind which will protect the tooth from further decay—protect the affected part against the influence of those agencies on which the disease depends. A material or class of materials should be selected that would not, under any circumstances, operate either as a local or a constitutional injury. There are several properties that materials for filling teeth should possess, one of the most important of which is *indestructibility*. This term is technically applicable only to compounds; but we venture here to expand its sense so as to indicate by it an *integrity of substance* as well in a simple as in a compound material; for, considered with reference to the purpose of filling, a combination of the simple with another substance, is as much a destruction as is a decomposition of the compound. Any substance, whether simple or compound, that will not maintain its identity and integrity when subjected to any conditions of the mouth, is wholly unfit to use as a material for filling. If compounds are employed, they should be such as would not be affected by the secretions of the mouth, by its temperature, or by its conditions. A mere mechanical mixture would not be an appropriate material; and all compounds of the metals, so far as we are familiar with them, are unfit for this purpose, by reason of the facility with which they are destroyed in the mouth.

The next most important property of a material for filling, is, *adaptability;* by which is meant a capability of being wrought into suitable shapes for the purpose,—a facility of being applied and conformed to the parts upon which it is to be placed. There are substances that would be entirely indestructible in the mouth, and that would be very desirable in other respects as materials for filling, yet that are altogether worthless for this purpose, from lack of adaptability. Quartz, if it possessed this property, would be valuable as a material; but as yet there has been discovered no method of preparing it in an available form. On the other hand, many things possess the property of adaptability, that are lacking in some other important particulars.

The next important property is, *hardness.* A material may possess all the other suitable qualities, and yet be too soft. A material should be hard enough not to be broken by any pressure or friction liable to be applied. This property is especially desirable for fillings in the masticatory surfaces of the molars and bicuspids. It would, however, be admissible to employ a softer material for filling cavities in the proximal surfaces of the teeth, provided it perfectly excluded all foreign substances.

Again, a material should be as nearly as possible a nonconductor of heat, particularly for filling sensitive teeth, or those liable to become so under the influence of slight causes. Extreme variations of temperature will, in most instances, aggravate sensitiveness, and, in susceptible cases, produce it; and, if the irritation is continued, the result may be necrosis. Gold, which possesses the largest number of desirable qualities as a material for filling, is in this respect very defective, being one of the best conductors of heat. To obviate this defect, some nonconducting material is employed between the gold and the sensitive portion of the tooth. The nerve is liable to be affected by sudden and extreme changes of temperature, transmitted to it through a gold plug.

In the next place, a material should be susceptible of being welded, or united into a solid mass. The permanency of an operation depends very much upon this quality. A filling having the different pieces which compose it perfectly consolidated, will be much more durable than if effected with a material in which this cohesive property is lacking, can be made with greater facility, and will be better longer retained; and mainly because such a fi cannot be destroyed piecemeal. Noncohesive ma rial is retained by the general form of the cav which is to be shaped so as to bind all the pie together, and thus *hold* them in place; but a su stance that will weld, requires only two or thr good retaining points, angles, or pits, properly sit ated, in order to be firmly and permanently fixe in a cavity of any form.

Color.—An other desirable property of a materi for filling, is, such a color as shall best harmoniz with that of the teeth, particularly if they are i front. In this respect, all the metals are objection able; though gold is probably less so than any of th others, the objection to this being not so much in it color as in its luster; which objection, however, ma be partially obviated by the kind of finish given t the work. In teeth of certain shades—semitrans parent bluish white, for instance—gold, for expose fillings, is very objectionable; indeed, in some case as unsightly as would be an entire absence of th tooth; and, in such instances, the darker metal would of course appear much worse. For such teeth some mineral substances would be most desirable.

Most of the materials employed for filling ar metallic; only a few nonmetallic substances hav been used, and these rather by way of experiment

Tin.—This metal has been, and is even yet, much employed as a material for filling. It is easily wrought into foil, and in that condition is readily adapted to the purpose, by reason of its softness and pliability. Fillings can be made with it in all cases in which nonadhesive gold foil can be used, to much of which, indeed, it can, by skillful manipulation, be made superior in adhesive property. Its quality, however, is greatly dependent on the manner of its manufacture. It is harder than lead, and in many cases hard enough for permanent fillings: we have known it retained in crown cavities of the molars, effectually preserving the teeth, for fifteen years. In favorable conditions of the mouth, it is not materially changed, not oxydizing easily, and not readily uniting with any substances liable to be brought in contact with it. But in an unhealthy mouth, with the secretions in an abnormal condition, and the teeth neglected, tin fillings are very rapidly destroyed. Such a change may take place in the mouth, as will in a little time destroy tin fillings that had long remained in good preservation; and hence this material is not entirely reliable in any case, since such change may at any time occur. Some cases seemingly favorable to its use, are found, on examination, to be otherwise; and in almost any mouth in which there is a large proportion of mucus secreted, it can not be depended upon for permanency. Its color renders it unfit for the anterior teeth. It is a less perfect conductor of heat than gold; on which account it is frequently employed where the latter metal can not be. It should not be used in a tooth in which there is an other metal; notwithstanding some economical dentists do sometimes use it to fill the interior of large cavities, placing upon it a covering of gold. This method is objectionable in two particulars: first, the tin is softer than the gold, and under much pressure yields beneath it, so as to destroy the integrity of the filling; and second, when the fluids of the mouth come in contact with the two metals, a chemical action is induced, by which the tin is rapidly oxydized. It is for this reason that no two metals should be applied to the same tooth; as, for instance, tin for filling a tooth round which there is a gold clasp, or in contact with which is a gold plate. Finally, the use of this material should be determined not only by all these circumstances, but also by the constitutional predisposition of the patient, and the character of the teeth, which should be dense and well organized, in order to render it at all admissible.

Silver.—This metal was formerly in more extensive use as a material for filling, than it is at present. It is not, for this purpose, superior to tin in any particular, except in being somewhat harder; and in some particulars it is inferior, being quite as de-

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may be made of well prepared platinum sponge, recently annealed. It requires skillful manipulation, however; for the least moisture destroys its cohesive property entirely. It is quite as good a conductor of heat as gold, and on this account equally objectionable. In the respect of color, too, it is undesirable. Platinum should never be placed in close proximity to tin fillings, or to gold plate or clasps of few carats. It is not now, however, used in filling at all, except for experiments.

Gold.—Of all the metals that have as yet been used for filling teeth, gold possesses more of the requisite properties than any other. It is more indestructible than any other, and sufficiently so for all practical purposes. Twenty-carat gold is very seldom affected by any agencies with which it is brought in contact in the mouth; pure gold, never. In the filling of teeth, there are two objects to be aimed at: one, a sufficient hardness to withstand the wear of mastication; the other, a thorough protection to the cavity against all foreign substances. For the attainment of the first of these, gold is not all that could be desired; yet it is, perhaps, as efficient in this respect as any other metal that can be employed. But the second object gold accomplishes perfectly; that is, so long as the filling maintains its integrity; after it has partially worn out, it thus far fails, of course. In adaptability, too, gold is superior to any other metal.

It can be elaborated into a variety of forms, with any of which very good fillings can be made. It can be perfectly conformed to any shape of surface, however irregular. A tooth that can be filled at all, can be filled with gold. This assertion was made a number of years ago; and if it was true then, it is much more true now; for then the adhesive property of gold was not employed at all, or even recognized as available; but now, this property has been rendered efficient and practicable. Then, our best operators did not aim to unite the different portions of gold of which the fillings were composed. The idea that such consolidation could be effected, seemed never to have entered their minds. Indeed, with the instruments and the method of manipulation then employed, this adhesive property could not have been made available; but as it came to be recognized, the instruments and the manipulation were adapted to the purpose. Formerly, an ordinary gold plug when removed from a cavity, would be separated into as many pieces as originally composed it; but now, when adhesive gold is skillfully used, the mass composing a filling can not be divided into its original parts, but may be wrought into plate, wire, or foil. Nonadhesive gold—the modification in which, till recently, it was always employed—would not weld, even under great pressure; but, in the mode in which it is now prepared, it will weld readily and thoroughly. There are certain requisites essential to this welding property of gold: if it is in the form of foil, it must not present a smooth, planished surface; it must be annealed after hammering, in order that its ultimate particles may be in the best condition for cohering; it must be entirely free from all deposits of foreign substance; and it must be kept from exposure to the atmosphere.

Gold is a good conductor of heat; and this is the chief objection to it as a material for filling. As to sensitive teeth, this is a very serious objection, in some cases necessitating the employment of non-conducting materials with it, and in others precluding its use altogether. The color of gold, however, is seldom an objection to its use; though it sometimes renders it unsuitable for fillings in the front teeth. But this objection has been already adverted to.

Various Preparations of Gold.—And first, of the manufacture of gold foil. For this purpose, pure gold is used; for procuring which, various methods are employed. But the most common of these are insufficient for the production of gold absolutely pure. It is, however, deemed irrelevant here to detail the process by which this end is attained: it is enough to premise that, for the manufacture of the best quality of foil, perfectly pure gold is indispensable. The gold is cast into an ingot about an inch wide, which is placed between a pair of rollers, and rolled down as thin as practicable, the piece, while rolling, being frequently annealed. It is then cut into squares, which are inserted with wooden pliers between vellum leaves, a hundred and sixty or seventy in a pack. Over this pack two pockets are drawn, inclosing it completely. The pack then, while it is carefully annealed, is hammered on a marble block, with a hammer weighing twelve or sixteen pounds, till the leaves are spread out to the full extent of the pack. Much experience and skill are requisite to the proper accomplishment of this part of the work: by a single unskillful stroke of the hammer, a whole pack might be spoiled.

Gold foil is numbered according to the grains contained in each leaf, ranging from 2 to 30. The most common numbers are, 2, 3, 4, 5, 6, 8, 10, 15, 20, and 30, the smaller, from 2 to 6, being in most frequent use. It has heretofore been a desideratum to obtain gold foil perfectly uniform; but some few manufacturers now seem to have attained this perfection.

Crystal Gold.—This form of gold was introduced to the profession about five years ago. Some experiments in this direction, indeed, had been made as early as 1825, by C. Ash, of London, and again in 1850, by Dr. S. A. Main, of New York. Their preparations, however, were simply precipitates, and nothing more. But in 1853, Dr. A. J. Watts, of

Utica, New York, obtained letters patent for his preparation of gold for filling teeth. This preparation was at first denominated sponge gold, but after some modification, received its present name. There are numerous formulas by which preparations of crystal gold may be made; but so far as we are acquainted with them, they are all embraced in two general methods: the one, to obtain simply a precipitate of the metal, adaptable to the filling of the teeth; and the other, to combine this precipitate with mercury, and obtain a definite crystallization. For the preparation of the sponge or crystal gold, the absolutely pure metal is required. This is dissolved in nitro-muriatic acid, the gold being added till the solution is saturated. Various materials may be used to precipitate it, the most common of which are sulphate of iron and oxalic acid, the latter on some accounts being preferable. The character of the precipitate will be determined, in a great degree, by the manner in which the precipitant is added: if slowly, the precipitate will be more fibrous, or structural.

A preparation may be made by introducing the precipitant gradually, and then carefully washing the precipitate, and heating almost to redness. For perfect crystallization of the gold, combine the precipitate with from six to twelve times its weight of pure mercury, let it stand a short time, subject to a gentle heat, and then remove the mercury with dilute nitric acid. Afterward wash the nitrate of mercury from the gold; place the latter upon a slide, and bring it up to a full red heat in a muffle, and the gold is then in a condition to be used for filling. This is about the formula on which a patent was granted to A. J. Watts. The preparation possesses some advantages over gold foil: it is as readily introduced; it is more capable of thorough consolidation; it has, besides the cohesiveness of foil, the additional property of interlacing its crystals one with another, by which property, even without cohesion, the pieces of a filling can be firmly united; and it takes a better hold upon the walls of the cavity, to which it presents edges and ends, so as to be more thoroughly adapted and fastened.

Amalgam.—By this term are designated all those preparations formed by a combination of mercury with various other metals; most frequently with silver and tin, but occasionally with gold, platinum, bismuth, cadmium, zinc, and lead. The several formulas for amalgam need not here be specified. The kind most in use is prepared by melting together and carefully mixing pure tin and silver, filing this mixture, when cooled, into dust, combining the latter with mercury in sufficient proportion to give the requisite plasticity, and then thoroughly washing the whole in alcohol or boiling water, to eliminate the oxyds formed by the combination of the metals. If there is a redundance of mercury, it may be removed by pressing the paste in a piece of chamois skin. This preparation may in some cases be used for filling with considerable success; but in no case can it be relied upon as a durable material, its destructibility being no less than that of tin or silver in any circumstances, and being greater where all the mercury is not removed from the surface of the filling, and the surface not burnished down solid and smooth. Mercury oxydates with considerable rapidity when exposed to air and moisture, and with increased energy, under the influence of heat, especially when some acid is present. This facility of oxydation is still increased when other metals are combined with the mercury. Oxydation of such fillings will in some cases be confined to the surface, wherever there is contact of moisture; in others, it will pervade the whole mass, rendering it black and spongy throughout.

Amalgam fillings, in a short time after their insertion, undergo a hardening process, caused mainly by evaporation of the mercury. The consequence is, either that the mass becomes porous, or that it contracts; the former, doubtless, in cases where the oxydation blackens through, and the latter, where it is confined to the surface. When a plug is in either of these conditions, the preservation of the tooth is very uncertain. On removing an ordinary amalgam plug that has been worn for some time, its entire surface will generally be found oxydized: and a tooth filled with this material generally becomes blackened, and its appearance ruined.

To such objections against this material, an other is to be added in cases in which there are fillings or plate of platinum or gold: galvanic action will be established, in a degree proportionate to the proximity of the metals and the condition of the secretions. This may occasion much mischief. Some constitutions are very susceptible of the influence of mercury; and a gradual decomposition of several amalgam fillings in the mouth, may seriously impair the general health. Therefore, before this material is ever employed, the health, temperament, habits of the patient, should be carefully noted; for these and other circumstances may often indicate its inadmissibility.

So great and so numerous are the objections to this material, that it is but little used by reliable operators. Its adaptability is the main property on which are based the arguments in its favor: it is easily applied, and consolidates with considerable hardness. It is affirmed, also, that teeth which cannot be saved with anything else, may be filled with this, and made valuable. This, however, is not true since the employment of the adhesive property of gold; which property renders this metal equal in adaptability to amalgam.

Nonmetallic Materials.—Of the nonmetallic materials experimented with for filling, there are not many worthy of any particular consideration. Indeed, gutta percha and its preparations constitute the chief nonmetallic substances now used for this purpose, though some others have been employed. Gutta percha is useful for temporary fillings, and, under ordinary circumstances, sufficiently durable. It is valuable for filling those teeth which it may be desirable to retain only a short time, or those in which it may be necessary temporarily to protect a sensitive part against the influence of irritating agents, in order to restore it to health. Gutta percha is not readily decomposed by the fluids of the mouth, when they are in a healthy condition. In some instances, we have known it worn in the mouth for years, with but little change. But in cavities on the grinding surfaces of the molars and bicuspids, it will not withstand the wear of mastication a great while, though long enough in most cases to subserve the purposes of a temporary filling. It possesses great adaptability: by simply being warmed over a spirit-lamp or in boiling water, it becomes plastic, and is with great facility introduced and conformed to the cavity. It may be applied also in solution, being dissolved in chloroform till it approaches a pasty consistence, then absorbed in a pledget of cotton, and introduced into the cavity;

where the chloroform, evaporating, leaves the gutta percha as a filling. The only objection to this method is, the contraction consequent on the evaporation of the chloroform. Another property that renders this substance highly valuable, is, its non-conduction of heat, it being in this respect as nearly perfect as any other material employed.

A preparation of gutta percha with mineral substances, known as *Hill's stopping*, has, for the last four years, been extensively used for temporary fillings; indeed, it has superseded simple gutta percha almost entirely. The aim of this preparation was to obviate two or three objections to pure gutta percha; as, its contractibility in the cavity, its softness, and its color. The composition of *Hill's stopping* is as follows: With pure gutta percha in a plastic state, are mixed quicklime two parts, and quartz and feldspar one part each, which latter are reduced to an impalpable powder, and kneaded into the mass as long as it will receive them without becoming brittle. Such is the formula given by the inventor of this preparation; though it is presumed that one of these materials alone, namely, pulverized quartz, would be found entirely sufficient, since it is capable, by itself, of quite as much as is attained by all together. The addition of gold or platinum filings has been recommended; but no advantage is thus gained. It was at first claimed for this material that it would serve for permanent fillings; but it was soon demonstrated insufficient. It was supposed, also, that it might be employed for partial fillings in large cavities, which could be completed with gold; but for this, too, it was found impracticable, since it did not make a sufficiently firm foundation.

This preparation is applied in the same manner as simple gutta percha, being warmed on a porcelain or metal slab over a spirit-lamp till sufficiently soft, and then packed into the cavity. It cannot be employed in the form of solution, nor should it be softened in boiling water. It may be conveniently prepared by dissolving the gutta percha in chloroform to almost a pasty consistence, then adding the mineral substances, and putting it into a vessel suitable for the evaporation of the chloroform. It should be made so thick, that the silex would not fall to the bottom. When *Hill's stopping* or gutta percha is used, as soon as the cavity is filled, an instrument with the end nearly as large as the orifice of the cavity, should be placed upon the filling, and retained there with considerable pressure till the mass is cool. We as yet know of nothing better for temporary fillings than this preparation of gutta percha.

CHAPTER IV.

INSTRUMENTS FOR FILLING.

In describing the instruments for filling teeth, it will be convenient to take them somewhat in the order in which they are employed in ordinary practice; first referring to those which are used for cutting away portions of the teeth, for the purpose of separating them, and for dressing off the borders of cavities; then to those for removing decay and forming the cavities; and finally to those for introducing, consolidating, and finishing fillings. The first, then, that claim our attention, are the

HEAVY CUTTING-INSTRUMENTS.

These are of the thick chisel shape. They should be of good steel, well wrought, and thoroughly tempered. Every step in the process of their manufacture should be most perfectly executed, so as to insure an edge that will cut not only dentine, but also enamel, which is the hardest animal substance. Various sizes of the straight chisel form are required.

In all cases they should be as thick as possible, without being thus impaired in their efficiency; so firm that there may be no springing or tremulous motion under the pressure they are required to sustain. For separating front teeth, however, they must be thin enough to pass readily into the intended space, and about one fourth of an inch wide at the edge. (See Fig. 2.) But, for separating bicuspids and molars, the instruments should be thicker and broader; as thick, indeed, as the respective intervals will admit. (Fig. 3.) In some cases, they should have the edge oblique, as in Fig. 4.

Fig. 2.

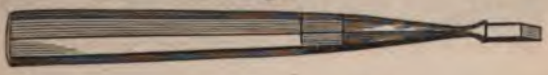
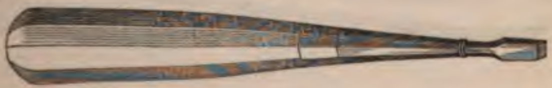
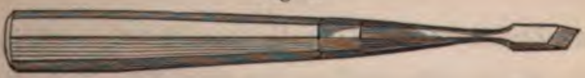


Fig. 3.



It is seldom that these instruments need any curve. The straight form is the best, unless, as it rarely happens, the point to be operated upon can not

Fig. 4.



be reached efficiently with it; as, for instance, in a small mouth, a slight anterior curve will be required in the shaft of the instrument, to facilitate its approach to the front proximal surface of a second or a third molar. (Fig. 5.) A heavy instrument, with a sharp point and a lateral curve, is often efficient in opening up cavities and cutting down strong projections of enamel. (Fig. 6.) This class of instruments we consider as valuable as any other in our case. Every operator should have at hand a sufficient variety to meet every demand.

Fig. 5.

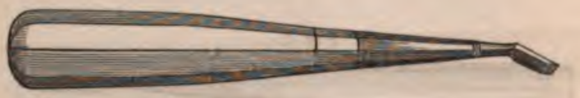
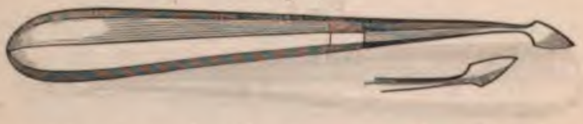


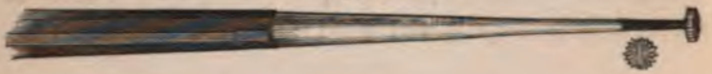
Fig. 6.



DRILLS.

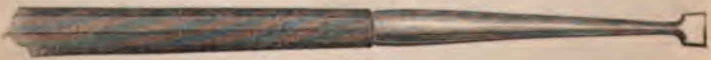
Bur Drills.—Of this indispensable class of instruments there are various forms. They should be manufactured of the best steel, and wrought with the greatest care. After having been forged as near the proper size as possible, the bulb is shaped by dressing with a fine file, or by turning in a lathe; those made by the latter method being superior, and cutting much more smoothly; they do not catch and jar as do those of less regular form. After the bulb is [illegible] it is usually cut [illegible] should be very regular and uniform. This should be made by machinery, though it is usually done by hand. Of these instruments, there should be a variety in size, the smallest considerably less than the smallest cavity the dentist ever attempts to fill—that is, about one thirtysecond of an inch in diameter, and the largest about one fifth of an inch. Inclusive of these extremes, there should be about fifteen sizes of each particular form. These instruments are used for opening cavities. With them a more regular and perfect orifice is made in small and medium-sized cavities, than by any other method. They are also used to some extent for forming the cavities, and even sometimes, in large cavities, for making retaining-points for a filling.

Fig. 10.



Common Drills.—Of an other kind of drills, Fig. 11 represents one with a square point, beveled from both sides, measuring from a half to a whole line in length, and attached to a small round shaft. The edges of the drills should be very hard, so that they

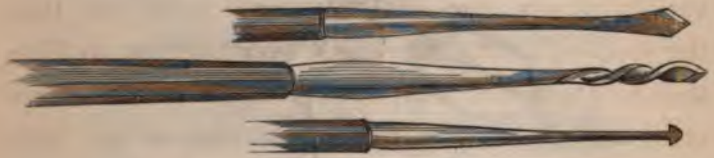
Fig. 11.



may cut with the greatest celerity. Of this kind, there should be about ten sizes, ranging in width from No. 15 to No. 25 of Stub's gauge. These are used mainly for forming retaining-points in cavities.

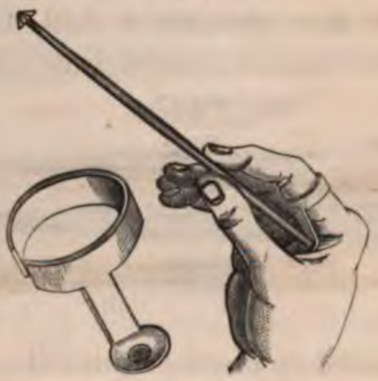
Fig. 12 is the spear-shaped drill, the edges of which are formed by dressing from both sides; or, it may be, from only one, in which case it will cut only when rotating one way. This shape is employed principally for drilling out fangs for filling or receiving pivot teeth.

Fig. 12.



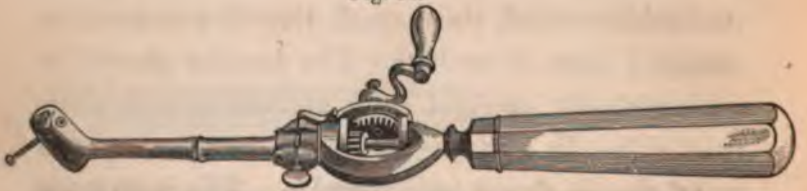
The burs and drills may be made of pieces of wire one and a half inches long, and fitted to a socket-handle that will accommodate a large number; or of a continuous piece of large wire. The latter is the preferable method, since much time is consumed in changing them in sockets. The handles should be made with six or eight sides, and cut on each alternate side. In the use of these instruments, the socket-ring is almost indispensable. This is an open ring for the middle or the index finger, with a socket attached, in which rests the end of the handle of the instrument. (Fig. 13.) The drill is rotated commonly with the thumb and fingers.

Fig. 13.



Drill-stocks of various forms have been invented, with the view of increasing the motion of the drill, of augmenting its power, or, especially, of bringing it to bear upon points inaccessible to the straight instrument. Some of these stocks are very complicated; as, for example, that denominated *Chevalier's*

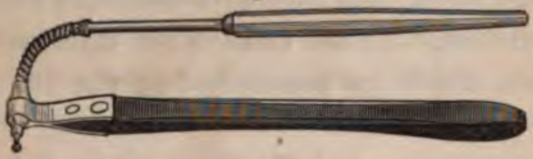
Fig. 14.



drill-stock, than which there are none better adapted for bringing the drill to bear in various directions.

(Fig. 14.) An other, more simple in construction, called *Merry's drill-stock*, has recently been introduced to the notice of the profession. With this, the drill can be applied at any desired angle, the operator having as complete control of the instrument as of the common straight drill. (Fig. 15.)

Fig. 15.

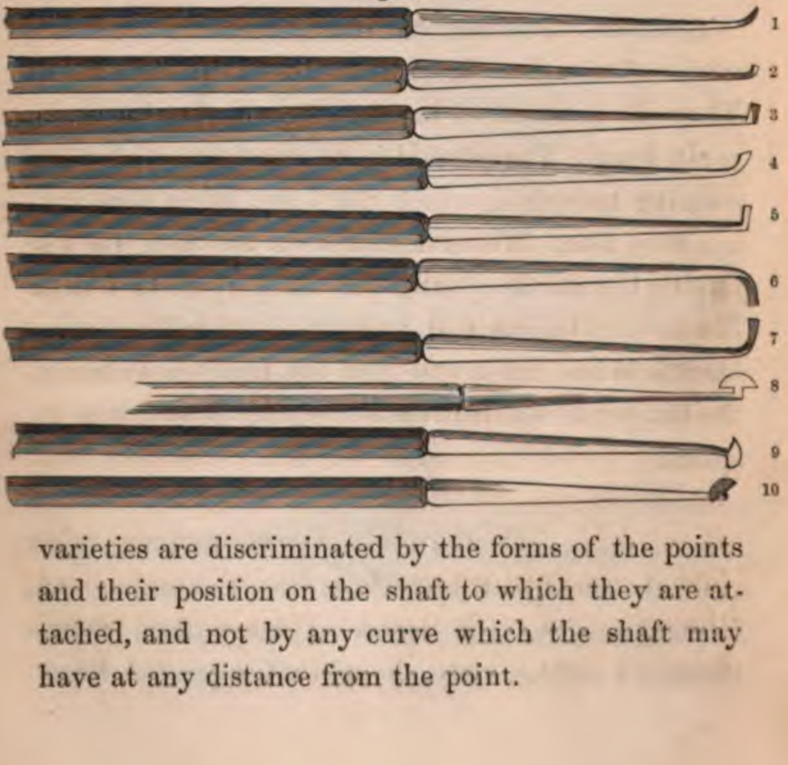


Broaches.—The broaches of three or four sides are made of the best steel, and are of various sizes. They are constructed both of a straight and of a tapered form. They should in no case have more than a spring temper, in which the color, when drawing, is a deep blue. These instruments are used for enlarging the canals of fangs for the purpose of filling. Six or eight sizes will probably meet all ordinary cases. When the course into the canal is tortuous, the temper of the instrument should be so low as to spring.

EXCAVATORS.

Of the small cutting-instruments for opening and forming cavities and removing decay from them, there is a great variety, though a few general forms comprise the whole. Hitherto there has been no very systematic arrangement of these instruments, such as the convenience both of the profession and of the manufacturers of dental apparatus would seem to dictate. In a classification that we have adopted and found very convenient, the classes are arranged by numbers, the most simple being placed under the first, and under each successive number a more complicated form. All the varieties are embraced in ten numbers, which are represented in Fig. 16. These varieties are discriminated by the forms of the points and their position on the shaft to which they are attached, and not by any curve which the shaft may have at any distance from the point.

Fig. 16.



No. 1 has simply a flat point slightly curved, with a round edge transverse to the shaft. Four sizes will be sufficient for ordinary purposes.

No. 2 has a flat point with a short curve, bringing the point to a right angle with the shaft; the edge is transverse. This differs from No. 1 in having the curve more short and abrupt, and the edge more nearly square. Four sizes.

No. 3 has a flat point with a square, transverse edge, which rises at a right angle from the shaft; the blade being from one to two lines in length. Four sizes.

No. 4 has a flat point, curved so as to be at a right angle with the shaft; the blade, from the center of the curve to the edge, being from one and a half to three lines, and the edge straight. Four sizes.

In each of the foregoing the edges should expand slightly in width.

No. 5 has a flat point with a square edge, which is parallel with the shaft, and rises at a right angle from it. The blade is from one half to two and a half lines in length, and from one half to one line in width, with no expansion at the edge. Six sizes.

Nos. 6 and 7 are right and left excavators, with flat points and double curves; the first curve being at an angle of about twenty degrees, and the other lateral, right and left, reaching from the beginning of the first curve to the point. The length of blade is from two to five lines. Four sizes.

No. 8 has a crescent-shaped point, the blade rising by a small attachment from the shaft, and making a right angle with it. The edge is a regular curve, describing about two fifths of a circle, and is parallel with the handle. The point should be perfectly formed. Six sizes.

No. 9. The form of the point is the same as in No. 8, the difference being in the position of the blade, the edge of which is transverse to the shaft, and rises from it at an angle of one hundred and thirty degrees. Six sizes.

In No. 10 the point has the same shape as in Nos. 8 and 9. The cutting edge is transverse to the shaft, and rises by a small neck at a right angle from it. Six sizes.

Such are the most important forms of excavators; though modifications will be required for particular cases. While Nos. 8, 9, and 10 are not in extensive use, a few operators have used them for some years, and prize them very highly. In many difficult cases they are far more applicable than any other instrument we have. For instance, in the formation of the cervical wall of a proximal cavity in any of the teeth, but particularly in the superior bicuspids and molars, there is no other instrument so applicable and efficient as No. 9: with it, that part of the cavity, so frequently neglected, is just as easily formed as any other.

Cases will occasionally be presented, in which some curvature of the shaft of the instrument will be requisite. But no more curve should be given than may be absolutely necessary, since it is impossible to manipulate with the same precision and delicacy with curved as with straight instruments. The degree of curve necessary in any given case will be determined by the position of the decay on the tooth, and the location of the latter in the mouth.

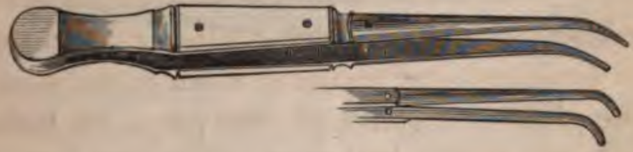
Of the Manufacture of Excavators.—For making these instruments, there should be selected the best cast-steel wire, No. 8. This should be forged down so as to leave the end large enough to form the intended point. Nos. 1 to 6 inclusive, may be formed by forging, and afterward dressing up with the file. Nos. 7 to 10 must be formed by the files out of a bulb left from the forge; for which purpose different forms and sizes of files will be required, in order definitely to shape all the angles and points. In heating steel, either for forging or tempering, a full red heat should in no case be passed, since a higher degree than this spoils it. After the points are formed, and made smooth with an emery stick or wheel, they are to be tempered; which is a delicate process, requiring much experience and care. The point should be warmed in a spirit-lamp, and then covered with soap, to prevent oxydation and scaling. The instrument is then brought up to a full red heat with a spirit-lamp, blowpipe, and charcoal, and suddenly plunged into a cake of soap or into cold water; when it will present a silvery whiteness: the steel in this condition is extremely hard and as friable as glass. It then should be polished off with an emery-stick or an oilstone, and drawn down to the proper temper. This tempering is accomplished by placing the edge of the instrument on a piece of cold polished steel or iron, and its shaft near or in the flame of a small spirit-lamp, and retaining it there till it changes to a deep blue color, graduated down to the point in a deep straw or copper hue. The purpose in holding the point of the instrument on a piece of cold polished iron or steel, is, that the heat there may be subject to complete control. The instrument is then to be polished with the emery-wheel and dressed up with the oilstone. Of the various methods of tempering, the foregoing is equal, and in convenience superior, to any other.

PLUGGING INSTRUMENTS.

For introducing and consolidating fillings, a great variety of instruments is in use. In filling with gold in some of the forms in which it is employed, the plugging-pliers are required, for picking up the pieces of gold and placing them in the proper positions in the cavity; in block-filling they are indispensable.

These instruments are made of different forms and sizes—of different forms, to facilitate access to cavities inconveniently located; of different sizes, to accommodate cavities of various capacities. For a large majority of cases, they require a slight curve, about half an inch from the point; for some cases, however, the curve will have to be right-angled. (Fig. 17.)

Fig. 17.



The points of the pliers, when shut together, should form the point of a plugging instrument, so that it may be used to some extent for consolidating the gold. This instrument should be about five inches long, and should have no guidepin.

The forms of condensing instruments may be multiplied to an almost indefinite extent. They are all, however, but modifications of two or three general principles. The particular form of the plugging point will be determined by the form in which the gold is used. With nonadhesive gold, small square, round, sharp points, of various curves, will all be required. (Fig. 18.) These points are easily kept in proper condition, and, in some instances, are used for years without any change or repair. But, with adhesive gold in any of its forms, the points all require to be serrated. There are three or four varieties of these, which it will be proper to describe. The first is square, and slightly bent about half an inch from the end, which is formed into four or six definite sharp points with the edge of a thin file. Of this variety there should be about three sizes, the largest entering No. 18 of Stub's gauge, and the smallest No. 25. The former should have six points, and the other two sizes four. (Fig. 19.) The cuts upon these are made directly across the end. In another variety, the end is rounded, and the file placed upon it at an acute angle with the side of the instrument, and the

Fig. 18.

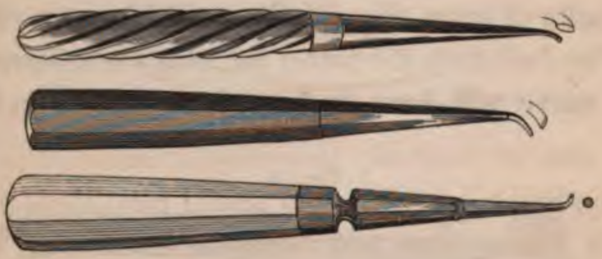
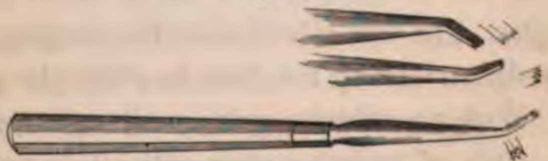


Fig. 19.



cuts, three in number, are made to the center of the point, which thus becomes triangular, or three-pronged, from a common center. (Fig. 20.) Four or five sizes of these may be employed, ranging from 18 to 26, Stub's gauge. A thin double point, from 26 to 28, is in many cases very valuable. Instruments with a condensing surface on the side, in stead of the end, will frequently be required for filling lateral cavities; these may be denominated lateral pluggers. (Fig. 21.)

Fig. 20.

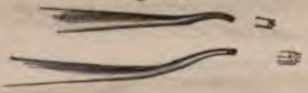
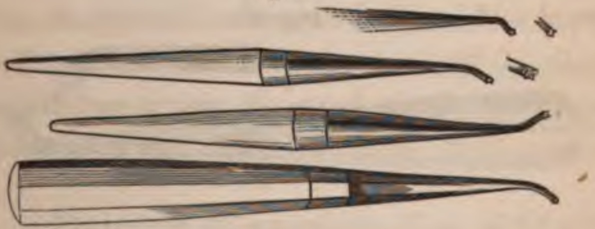


Fig. 21.



This condensing surface should also be serrated, as already described. An instrument square at the point, ranging from 18 to 22, and cut upon the end by passing it along the cuts of a file both ways, thus making a large number of small serrations at right angles across the point, is valuable for consolidating the surface of a plug. (Fig. 22.) Operating superficially, on the principle of the more deeply serrated instruments, it yet leaves the surface free from deep pits or indentations, and still so impressed that it will receive and retain more gold, if necessary, as it would not do, if the end of the instrument were perfectly smooth. A smooth-pointed instrument may be applied after all the gold has been added.

Fig. 22.

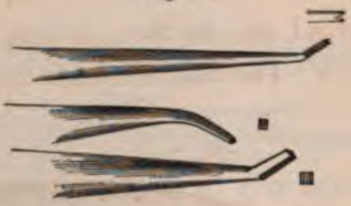


Fig. 23.

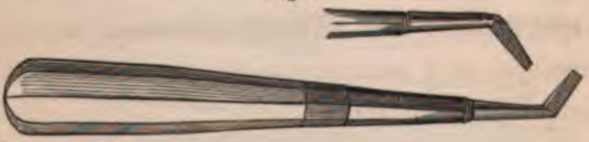
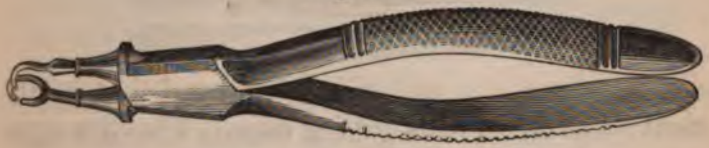


Fig. 23 is an instrument with file-cut sides. It is valuable for dressing down approximate fillings to a uniform surface. There may be two, one with the sides parallel with the shaft, and one with its sides transverse to the shaft; it terminates in a sharp edge.

In many cases a valuable instrument for consolidating is the plugging forceps, the general form of which, except the beaks, is that of the ordinary straight extracting forceps. The beaks are formed into sockets for the reception of the plugging points, one of which is of the common construction, but the other has a broad flat surface, to rest against the tooth. (Fig. 24.) This instrument is applicable only in certain cases, principally in filling proximal cavities. Its main advantage consists in its capability of applying a strong pressure upon the filling, without affecting the socket. Manipulation with it is less rapid and definite than with the ordinary condensing instruments; and with it, too, there is much danger of fracturing friable teeth.

Fig. 24.



THE FILE.

Of this valuable and indispensable instrument there is a variety of forms used by the dentist. The thin files (Fig. 25) are chiefly applicable to the anterior; the thick, heavy, knife-shaped (Fig. 26), to the posterior teeth. The latter, to facilitate their approach to the points operated upon, have various curves, some single, others double; the double being preferable, since they bring the handle of the instrument on a line with its cutting edge. The cuts upon this instrument, too, are quite various; in size ranging from very coarse to very fine, and in obliquity from a line almost at right angles across it, to one at an angle of fortyfive degrees. These cuts, too, are either single or double, the double being those made across one an other. The single, however, are preferable for all operations on the teeth; and the more

Fig. 25.

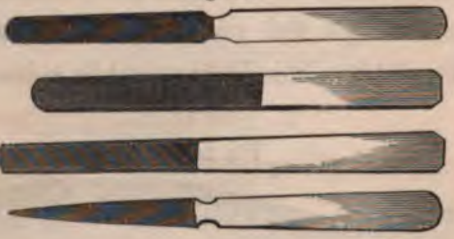
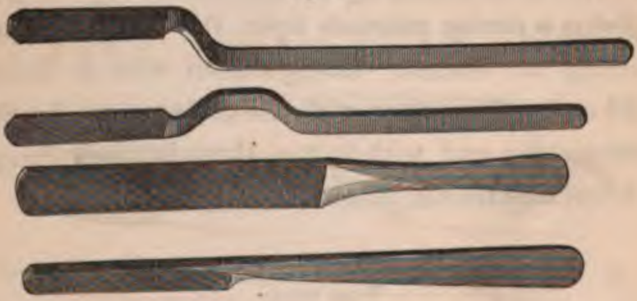


Fig. 26.



oblique are to be recommended, since they cause less of that jarring, unpleasant sensation to the patient.

There are in use various forms of file-carriers, one of which is represented in Fig. 27, the chief advantage of which is, that they retain the file much more firmly than it can be held in the fingers. These carriers are made with a variety of curves, to accommodate different positions. There is also a great variety of small file-point instruments for dressing down fillings, the more important of which are represented in Fig. 28.

Fig. 27.

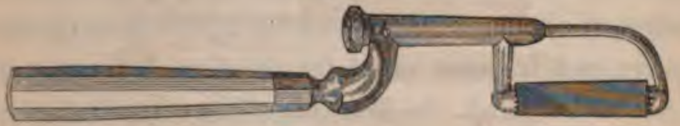
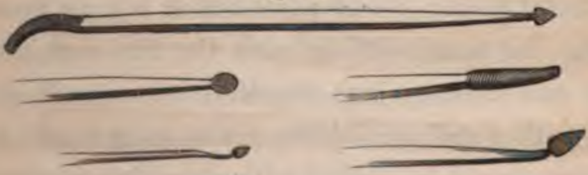


Fig. 28.



The Use of the File.—When a separation of the teeth is requisite, preparatory to filling, it is accomplished, either in whole or in part, with the file. Principally, in such a case, its use is restricted to finishing and smoothing, after the greater portion of the work has been done with the heavy cutting instrument. The file is valuable for removing superficial decay, being called into frequent requisition in caries of this kind. It is employed to dress off fangs preparatory to the insertion of pivot teeth; for which purpose it is required to be of a round or half-round form. It is used for dressing off sharp portions or edges of the teeth, that may be injurious to the soft parts, and in some cases for dressing down a tooth that is elongated. In finishing fillings it is indispensable. It was formerly used to some extent in the treatment of irregularity; but for this purpose it is now, or should be, abandoned.

Mode of Using the File.—The patient should be conveniently seated, with the head on a firm support, and under the control of the operator, who should occupy a position at the right of the patient in most cases, so disposing the head of the latter as to give the freest access to that point which is to be operated upon. In manipulating with the file, considerable skill and delicacy are requisite. It should not be held with a stiff, unyielding grasp, so as to catch and jar, but should be applied with a gentle pressure, and drawn across the tooth with a free and flexible motion. It should be frequently moistened, and not allowed to clog with the filings, being kept free of these by constant applications of the brush. A sharp, new file, with a quick, light movement, will cut far more rapidly, and less unpleasantly to the patient, than one that is dull or clogge with a heavy pressure. If the tooth bon tive, the file should be moistened in w When a file has become clogged with the may be perfectly cleaned by immersing hours in dilute hydrochloric acid, and th boiling, and finishing with oil. The fo may be changed by drawing the temper as desired, and then retempering.

The teeth, while being filed, should b by the fingers, or by an instrument for t or a cork or a piece of soft wood may between the tooth being filed and the t opposing jaw, and the pressure thus use port. The tooth being sustained in th there is less jarring experienced by the p less liability to produce irritation of the When filing the anterior teeth, it is gene to hold the file in the fingers. For filing t and canines, a thin, bevel-edged file is ferred. In dressing a tooth with a file, th is used should be a fine one; after the app which, the surface operated upon should b smooth as possible with a stone and bur with a buff charged with rotten-stone.

In separating teeth with the file, where decayed, care should be taken not to cut one. For this purpose, it will often be nec have a beveled edge on that side of the file next the sound tooth: in no case of this kind should a square-edged file be used. In cases in which it is necessary to file teeth that are somewhat loose in the sockets, and whose periosteum is in a state of irritation, to build up a wall of plaster of Paris round them, permitting it to harden, will very much facilitate the operation. This method is especially to be recommended in cases where it is necessary to dress off a considerable portion from the end of one or more inferior front teeth. There are some teeth upon which the use of the file is hardly admissible; as, for instance, those which are highly vascular and predisposed to inflammation of the dentine. Because the teeth of young persons are of this character, they should be filed but rarely, if at all; but, in general, those of adults may be filed, if properly, with impunity. The file should not be used upon the teeth, when the periosteum, the gums, or the mucous membrane is in a diseased condition, or strongly predisposed to such a condition. It should never be used for the correction of irregularity of the teeth, especially when they are sound; nor should it be employed to separate sound teeth to introduce clasps.

Filing of the teeth is an operation against which there has been, and still is, much prejudice, though without sufficient cause: whatever injury results from this operation, is mostly from the imperfect

CHAPTER V.

SEPARATION OF THE TEETH.

In most cases of proximal decay, the teeth, before the operation of filling can be performed, must be separated; though cases are not unfrequent, where the space between them is sufficient to admit of free manipulation without this preliminary. An imperfect accomplishment of this first step in the process of filling, is a prolific source of the many failures, in proximal cavities, to attain to efficient and durable results; for, unless this step be thoroughly performed, so as thus to make room for the free introduction and use of the various instruments requisite, no part of the work can be complete. Though the most common object for which teeth are separated, is, to obtain space for free manipulation with the instruments in filling, yet there are various other objects for which they have been separated, but many of which are now better reached by other means. It is sometimes necessary to cut away more than would otherwise be requisite, in order to remove thin, friable edges of the cavity, so as to obtain borders firm enough to sustain the filling. Teeth are in some instances separated for the introduction of clasps; a practice always to be deprecated, since it usually proves highly injurious. Though the practice was once very common, yet many of our best operators have now, with good reason, abandoned it altogether. At one time, too, it was a general practice to separate the teeth to relieve a crowded condition; but this, also, has been abandoned.

There are two methods of separating the teeth: the one, to cut away a portion; the other, to force apart by pressure, acting upon one or more teeth, as the circumstances admit. Formerly, all separations were effected with the file, and this of very crude form and cut; by which instrument, especially in unfavorable cases, much injury has been done. Though the file is a valuable instrument, one that no other could supply, yet, for removal of any considerable portion of dentine, it is not to be recommended. Its action upon inflamed dentine is exceedingly painful, besides being tedious and wearisome to patient and operator; and it is liable to irritate the external periosteum, and to increase inflammation. When a separation is to be made that requires the removal of a considerable portion of the tooth, the chisels, or heavy cutting instruments, are to be preferred. These, if of the proper form and temper, and in good condition, are very efficient for the purpose, performing the work far more rapidly than the file, and far less unpleasantly to the patient. They effect the removal of sensitive dentine with but little or no pain, and without liability to increase the inflammation, or to produce irritation or disease of the external periosteum. The force of these instruments is sustained by the entire attachment of the tooth, their pressure being applied almost in a line with its axis. Besides, by their use, the contiguous teeth are not liable to injury, as by the use of the file they often are.

The manipulation with these instruments is very simple. For separating front teeth, the instrument is firmly grasped in the hand, the thumb placed on the points of the teeth, and the edge applied at the point from which the portion is to be removed, and pressed gradually toward the gums, not thrust into the interval as a wedge before it has freely cut its way. In this manner, as much of the dentine as it is desirable to remove, is cut off in a few moments. This class of instruments is invaluable for forming the V-shaped spaces between the bicuspids and the molars. It requires a prolonged use of the file to make these separations properly; and hence the practice of attempting to fill proximal cavities without any separation at all, by operating through a small opening at the crown angle of the tooth, or a small hole drilled through its outer or inner portion. With the heavy cutting instruments, points upon the teeth, that the file cannot touch, are approached and operated upon with facility.

But the method of separation by pressure is, in many cases, to be preferred, especially in the case of anterior teeth, whose natural form it is important to preserve. In order to a successful separation in this manner, there must exist certain conditions. In the first place, there is to be sufficient space between the contiguous teeth to allow the desired separation; for, if all the teeth are remaining and stand close together, it will be impossible to effect much separation by pressure; but if there is a slight space between some of the adjacent teeth, or if a neighboring tooth has been removed, the object may be readily attained. The gums, periosteum, etc., should be in a healthy condition; for much injury may be done by attempting to separate teeth by pressure, when the contiguous parts are in an irritable state. In persons of a neuralgic diathesis, in those whose vital energy is weak, and particularly in those whose constitutional tendency is inflammatory, this operation is scarcely admissible. If, in such cases, it is attempted at all, it should be proceeded with very carefully and gradually, and would better be preceded by constitutional treatment. There are some cases in which it is best to make the separation partly by pressure, and then to complete it by dressing off the thin, friable edges of the cavity with the cutting instrument or the file. Whether the process is to be wholly or only partly accomplished by pressure, should be determined beforehand.

Various materials have been employed for separating the teeth by pressure, the chief of which are cotton, wood, India rubber, and ligatures. The condition and character of the parts to be operated upon will indicate the material best adapted in any given instance. In a good constitution, with the teeth firmly set, and the contiguous parts healthy, wood or India rubber may be applied; but in cases of an opposite character, a more yielding and tractable material is indicated. The degree of pressure to be applied and continued, will be determined by the susceptibility of the parts to irritation. Soreness usually occurs in a few hours after the introduction of the material. The pressure should be gradual and constant, slight at first, and increased in force as the patient will bear; the increase being made every day, and continued till ample space is obtained. The time necessary for the completion of this process is from ten to twelve days; only one separation should be made at a time. The teeth should be retained apart till the soreness has abated, before the operation. If not thus retained too long, they will return to their former position. It is by some supposed that separation by pressure is admissible only in the case of the young, or those under thirty years of age. It is true that they are the most susceptible; but the operation is, under favorable circumstances, proper at any age.

CHAPTER VI.

FILLING OF TEETH.

The operation of filling teeth is an interesting and important one, requiring for its successful accomplishment peculiar talent and large experience. It is the only means as yet ascertained of completely effecting the object for which it is employed, namely, arrest of decay and preservation of the organs. Therapeutic agents avail but little here, so low is the organization, and so feeble the vital power. Nature, so efficient in more highly organized structures, does but little, in disease of the teeth, toward arrest or restoration. Yet, on the other hand, these organs are less liable to decomposition by the action of foreign substances; indeed, the enamel is almost invulnerable to any agents to which it is ordinarily exposed. The dentine, however, is more easily acted upon, and, when there is defect in the enamel, is very liable to injury.

Scarcely an individual in our country arrives at mature age with a perfect set of teeth; indeed, nine tenths of our people have decayed teeth at an early period of life. Hence, for beautifying, preserving, supplying these organs, art is in constant requisition; and, in these respects, art has made great achievements. In the operation of filling the teeth, especially, its achievements are conspicuous; and here is scope for the highest skill. Every successive step in the process of filling a tooth demands a complete and conscientious application of the most efficient and best adapted formulas of the art. In the following remarks, it is proposed to analyze this whole process, examining, in their order, the various steps necessary to be taken, and endeavoring to inculcate the true methods of accomplishing them.

EXAMINATION.

When a case is presented, there should first be a thorough examination, since by this all the subsequent work will be modified. The points to be noted in the examination are as follows:

The temperament; the present health; the constitutional tendencies; the secretions, the saliva and the mucus; the mucous membrane and the gums; the constitution and condition of the teeth; the number of them remaining in the mouth; the number affected; and the extent and nature of the decay, and the character of the agents producing it. By the examination we ascertain how to proceed in the operation; if much or but little labor is required;

whether the operation will be a simple or a difficult one; and if difficult, what circumstances render it so: and, besides, some conclusion is arrived at in regard to the permanency of the operation.

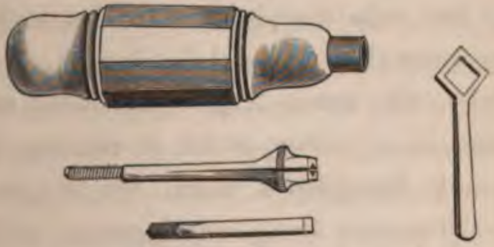
OPENING.

The next step is to open the cavity of decay, so that it may be approached and operated upon at all points. The particular manner of performing this is determined by the extent of the decay, and its position upon the tooth. In all cases the opening should be such as to give free access to all parts of the cavity, for removing effectually the decayed portion, for perfectly forming the cavity, and for introducing and thoroughly consolidating the filling. In central crown cavities of the molars and bicuspids, the projecting or pendent portions of enamel should be cut away. There are cases, however, where such portions are firm and not liable to be broken, and where they can be well sustained by filling under, in which it is admissible to leave some projection. This is true of only those teeth which are of good, firm texture. There are these two objections which may exist to these abrupt projections of enamel: it is very difficult, and in many cases impossible, to fill perfectly beneath such portions; and again, they are very liable to be broken down during mastication.

For opening up these cavities, in many cases the bur drill alone will be quite sufficient; those of different sizes being employed, to open up the orifice gradually, so that too much violence may not be done to the teeth. In all very small cavities, the bur is all that is required.

In cases where the decay is more extensive, and the cavity larger, the chisel or heavy cutting instrument, in connection with the drill, will be found very useful. An instrument first brought to the notice of the profession by Dr. Forbes, is very valuable for opening and enlarging crown cavities of the molars. It consists of a socket-handle, which receives a screw-clamp, and this receives the bits; which are of various forms, such as the gouge-, chisel-, and V-shape: these fit into the clamp, and are grasped by it, as it is screwed into the handle. (Fig. 29.) By its use the operation will be very much facilitated, and less jarring will be communicated to the tooth; but after

Fig. 29.



it is used, the bur will be required to give a smooth, uniform border to the cavity. In these cases, the orifice should be almost or quite as large as the cavity within. In proximal decay, the cavity must be sufficiently exposed to enable the operator to see distinctly into it, and to manipulate freely, in all parts of the operation. These cavities may be exposed by the use of the chisel or the file, or by pressure.

REMOVAL OF DECAY.

After the cavity is opened, the next step in order is the removal of the decayed dentine. As a general rule, this should be entirely removed. There is, however, some variety of opinion upon this subject. This difference of opinion is in regard to cases where an entire or a partial decomposition of the dentine has taken place quite to the pulp, and where, by its removal, the pulp would be exposed. It is maintained by some that decayed dentine affords a better protection to the nerve than any artificial covering; and hence it is better to let it remain, since its adaptation to the pulp is more complete; and it is not in every sense a foreign substance.

On the other hand, it is contended that the decayed dentine, being in an abnormal condition, will irritate, and in many cases ultimately destroy the pulp. And again, that there is danger of making

There are some particulars in regard to the removal of decay, however, about which there is no diversity of opinion: first, that all decomposed dentine should be removed from all parts of the cavity, where the pulp would not be exposed or injured thereby; and that in *all* cases it should be entirely removed from the lateral walls of the cavity, and especially from the vicinity of the orifice. Even discolored dentine should be removed from this point.

Dentine often becomes changed in color when there is no apparent decomposition; such portion is usually, though not always, without vitality. It is not important to remove such changed portion, except for the appearance of the tooth; it will produce no change upon the living or normal part beyond it; and it is better material to be in contact with the living part than the metal of which the filling is made.

Decayed dentine is readily removed with the excavators. In any given case, such instrument should be selected as would be best adapted for the purpose, as well in regard to size and the form of its edge, as to the curvature, or inclination, of its shaft. The edge of the instrument should come upon the walls of the cavity at such an angle as to accomplish the work most efficiently. It should be very sharp, and pressed firmly to the bottom of the decay at one side, so as to remove the principal part at one cut. With the proper instrument, and that in the right condition, all the decay should be removed from any cavity by a very few, firm, steady strokes. By this method less pain is caused the patient, and the work of the operator is facilitated. It is intolerable to think of being subjected to an awkward, clumsy hand, with a dull, ill-shaped excavator, scratching upon the surface of a decayed tooth, for a length of time, apparently to the patient, interminable.

FORMING CAVITIES.

The next step in the operation is the formation of the cavity. By this the cavity is so formed that it will retain the filling when properly introduced. In very few cases is the cavity of proper form when the decay is removed. Much time, patience, and labor are required of the operator, for the proper accomplishment of this part of the work, and much endurance on the part of the patient. Excavation is often necessary to give a regular form to the cavity; and in this process there are several particulars worthy of consideration. The great object, however, is to give to the cavity such a form as will most certainly retain the filling in place. The cutting for the formation of the cavity should be accomplished with the least possible loss of healthy dentine; which is a point upon which good judgment should be exercised.

The strength of the walls of the cavity, and the ability of the parts to withstand the pressure, both in the introduction and consolidation of the filling and in the act of mastication, should be well noted. It may be regarded as a rule from which there should scarcely ever be a departure, that the enamel should never be encroached upon in excavating to give form to a cavity. When there is but a lining of dentine at any given point on the enamel, after the decay is removed, it should remain for the preservation of the enamel; it should not be cut through either by pits or by grooves, much less should any considerable portion be removed.

There are cases occasionally in which the dentine is wholly decayed, and its removal lays bare the enamel; when such a case occurs, the enamel should be retained as perfect as possible, and no attempt made to form pits or grooves in it. The reason for this is found in the friability of the enamel.

It may be regarded as an axiom, that where it is necessary to cut the healthy dentine to give proper form to a cavity, it should be done at that part of the cavity where the tooth will suffer least from the loss. The precise point and amount of cutting will be determined by the form and size of the cavity, and the amount of solid dentine remaining after the decay is removed.

In small cavities, where there is sufficient material to work upon, the object is to give the cavity a regular form, and make the retaining points where it is most convenient.

In large cavities, where one side of the tooth is weak, places must be selected for making the retaining points, that will not affect the weak point. Frequently, in proximal decays of the anterior teeth, the labial and palatal walls are friable, and would be easily broken; much cutting upon such walls would not be admissible. Again, the decay often extends toward the point of the tooth, down to the union of the labial and palatal plates of the enamel; in cases of this kind, all that can be done at this point is to remove the decay; and fracture will sometimes occur, even in accomplishing this.

In some cases, as in the crown cavities of the molars, the cavity will be nearly or quite of proper form when it is perfectly opened up, and the decay all removed. This is the case when the decay is confined to a simple perforation of the dentine, without any lateral extensions. In proximal cavities, there is always more or less excavation of the solid dentine required, to give the cavity proper form.

There is no definite rule for the formation of cavities, that will be applicable in all cases. The form will be modified by the tooth, the position of the decay upon it, and the extent and ramifications of the decay. It is given, by some, as a rule, that the

depth of a cavity should be equal to its least diame
This is a direction, however, of no general appl
tion, for many cavities will be much deeper than
greatest diameter, as in crown cavities of the mola
and the reverse will often occur, as in labial cavit
of the superior incisors, and in proximal cavities
the molars, in which it would be impossible to ma
anything like an approach to this rule, without
posing the nerve, and even cutting through the ner
chamber.

A general direction, and one that we think go
and applicable in many cases, especially in cro
cavities of the molars, and in almost any of the de
perforations by decay, is, to make the walls of t
cavity as nearly as possible parallel with one an oth
This rule is applicable in almost all small cavities.

In medium or large-sized cavities, it is admissi
to leave them slightly larger at the bottom than
the orifice, if circumstances require; a large cavity
this form can be perfectly filled, when a small c
could not, from the fact that, in the former, there
more room to manipulate with the instrument,
introducing and consolidating the filling.

Cavities that are larger within than at the orifi
should have their walls perfectly plain, smooth s
faces, free from transverse grooves or depressions,
that the gold may be perfectly adapted to them.

It is sometimes necessary to leave a cavity sligh little transverse grooves upon one side will be sufficient, and in no case on more than two sides, leaving the others perfectly plain surfaces.

In the formation of retaining points in difficult cavities, there is considerable diversity of practice—undercutting and grooving have been very commonly employed. An other method has been very frequently adopted during the last three or four years, namely, that of drilling little holes or pits into the dentine at the most favorable points, these taking different directions. This kind of retaining points is much better calculated to answer the purpose, in filling with crystal gold, or adhesive foil by Dr. Arthur's method, than with the ordinary foil after the old methods. When these perforations are made at different inclinations, and then perfectly filled with adhesive gold of any kind, the filling will certainly be retained in place. For making these perforations, an English broach and a small square-edged drill are quite sufficient.

Such retaining points are seldom or never required in crown cavities of the molars; but in proximal cavities they are frequently employed with great advantage. In forming them, great care should be exercised, lest the nerve-chamber is approached by the instrument. In almost all cases, the proper point for forming them is at the bottom of the cervical wall of the cavity.

An other particular to which attention should be given is the border of the orifice. It should always be an object to secure an *even*, *smooth*, and *strong* border to the orifice of the cavity. It is impossible to make a good finish with a rough, uneven border; the filling is also more exposed to injury by mastication. The integrity of a smooth, plain surface is perfectly retained under influences that would break up and destroy an uneven one. It is also very desirable to have a *firm* margin; to obtain this, it is often necessary to cut away more than would otherwise be desirable. A smooth, firm border should not be sacrificed for the form, and especially in the posterior teeth. It is very objectionable to some persons to have the perfect form of the front teeth marred or changed; but it should be remembered that even a front tooth, one third cut away, and so filled as to be permanently preserved, is far more valuable than an artificial one.

An other particular that should always be observed, is, to obviate all acute angles. These are seldom or never found in proximal cavities of the molars and bicuspids; occasionally they are found in proximal cavities of the cuspids, and frequently in proximal cavities of the incisors, particularly at that part of the cavity next to the cutting edge of the tooth. Such angles are very often found also in crown cavities of the molars, where there is an extension of the decay along one or more of the fissures of the crown.

It is difficult—almost impossible—to fill perfectly a sharp angle, and hence the necessity of obliterating such when they occur. This may be done either with a small delicate cutting instrument, or with a small bur drill. It is an operation requiring great care and delicate manipulation, at least so far as the anterior teeth are concerned. When a sharp angle occurs in the proximal cavities of the front teeth, it is usually near the cutting edge of the tooth, just at the union of the labial and palatal plates of enamel. A small chisel-shaped instrument is very good for cutting out such angles: indeed, in fissures of crown cavities of molars, where the decay extends backwards, the straight, chisel-shaped instrument is just adapted to this purpose; but when there is an anterior extension, the instrument should be curved to almost a right angle, and forced down by pressure of the thumb of the left hand. Some good operators recommend a slight reaming at the orifice of all cavities, where it can be accomplished. The object of this is twofold: to remove the sharp angle at the orifice of the cavity, as it is liable to be roughened in putting in the filling; and to give a better border to the filling. In making this bevel, the bur, if one is used, should be but little larger than the orifice of the cavity. The cutting should be but slight—just sufficient to remove the sharp corners; much cutting here would give too thin and yielding an edge to the filling.

DRYING CAVITIES.

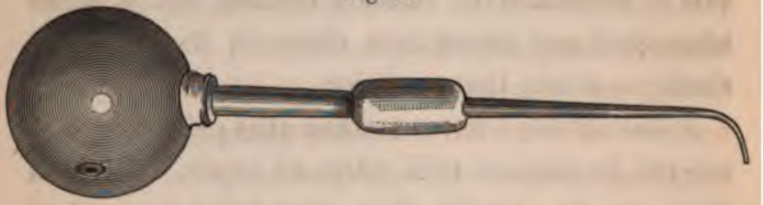
After a cavity is properly formed, it should be thoroughly cleaned and dried. Every particle of detached bone or foreign substance should be removed; during the excavation every thing should be kept out, every fragment removed as soon as it is detached; but generally there is something of the kind to remove after the cavity is formed. This may be done probably better with a syringe than by any other method; this, however, used in connection with a moist lock of cotton on a probe, will serve to remove every extraneous material that may be in the cavity. Any foreign substance remaining in the cavity prevents a perfect adaptation of the gold to the part, and consequently as perfect an attachment as would otherwise be obtained. After washing out thoroughly, wipe out with successive locks of dry cotton, till all the moisture is removed. The ordinary cotton will not accomplish this very effectually. By washing cotton in sulphuric ether, it is much improved for this purpose. The ether removes a peculiar oily substance from it, and thus increases its capacity to absorb moisture. Ether or chloroform will either answer the purpose; or a boiling of the cotton in water in which there is a small portion of carb. soda, or some such alkali, for a short time, will accomplish the same thing. Bibulous and blotting paper have been employed for this purpose; and by some they are preferred. Prepared flax has likewise been used. Either of these is no better than cotton well prepared. The respect in which the paper is any better than common cotton, is, that it has the same treatment in effect as the prepared cotton.

With none of these things can a cavity be made absolutely dry. It is not necessary to have absolute dryness to make a good filling, yet a more perfect filling can be made where that condition is obtained. Gold takes a better hold upon a perfectly dry, than upon a moist surface. This is quite apparent in the following experiment: Place two or three blocks of gold in any ordinary cavity, wiped as dry as possible, and press them firmly in place, consolidating them as much as would be done in filling, and then test the attachment by removal. Afterward reduce the same cavity to absolute dryness, take the same amount of gold, in the same form, and place it in the cavity, and consolidate as before, at the same point in the cavity; and then test its attachment in the same manner. The latter will be found much more firmly attached than the former.

But it is objected that this is useless, inasmuch as the natural moisture of the tooth is removed, by producing absolute dryness, and that this will soon return, and then the cavity will be no dryer than it could have been made with good cotton or paper. Admitting this, perfect dryness will remain long enough for the introduction of the filling. And if this is facilitated by absolute dryness, and a better adaptation and attachment obtained, then it *is* desirable to obtain that condition.

It has already been remarked that perfect dryness can not be obtained with cotton or paper. To warm these on a hot metallic plate, after being wrapped on the instrument, will very much increase their efficiency in removing moisture. Asbestos wrapped on a small bulb-pointed instrument, and heated, is very good for drying out cavities; with it, perfect dryness can be obtained, as it can be reheated and applied as often as necessary. To prepare this, select a proper-sized bulb-pointed instrument; a worn-out bur drill answers well; and fold over it fibers of asbestos, passing them a little way beyond the bulb on the shaft of the instrument, and there binding them firmly on with fine platinum wire; and the instrument is ready for use. An other method of obtaining perfect dryness—one that is very certain in its result—is to throw a jet of warm air into the cavity. This is accomplished by a little instrument, simple in structure and easily used. (Fig. 30.) It consists of a small blowpipe with a cylinder an inch long, and half an inch in diameter; this is placed down within two inches of the point of the instrument. This cylinder is either made of very heavy metal, or filled with wire or something that will retain heat; on the other end is attached a stiff India-rubber ball with an opening one and a half lines in diameter. By placing the thumb upon this opening, and making compression, a jet of air is forced through the point of the pipe, and the cylinder being previously heated, the temperature of the jet will correspond with that of the cylinder, and the velocity with which it is forced through the instrument. This jet thrown into a cavity that has been made as dry as possible by wiping, soon makes a very perceptible change, the walls of the cavity becoming whiter than before. This we consider the most desirable condition in respect to dryness, that can be obtained.

Fig. 30.



INTRODUCING THE FILLING.

Having, in all the steps for the preparation of the cavity, made thorough work, the next thing to be accomplished is the introduction and consolidation of the filling. The manner of performing this part of the work will be governed by the kind of material employed, and also, somewhat, by the form of the particular material. Some materials, as gold, for instance, may be used in three or four different forms, each involving a principle peculiar to itself; and each of these forms is susceptible of being used in different ways. It is proposed, in the first place, to describe the best methods of introducing gold, in the various forms in which it is or has been employed, considering also the merits of each.

The first method for consideration is that of filling with ordinary gold foil. The principles applicable to the use of this kind of foil also obtain in the use of foils of other metals. Gold is used far more than any thing else. The common, and, indeed, the almost universal method of using foil, at one period, was in the form of a roll, or rope, as it was sometimes called. By this method, the foil is cut into strips from one third of an inch to two inches wide, the width being governed somewhat by the size of the cavity to be filled. This strip is then rolled lengthwise, forming a loose roll. The compactness of the roll should depend upon the size of the points with which it is to be condensed; the smaller the points, the more compact the roll may be.

It may be introduced either with the condensing instrument or with the plugging pliers (improperly sometimes called plugging forceps.)

If with the former, it is taken up at one end on the point of the instrument, and passed to the bottom of the cavity; and that portion within the cavity is pressed firmly against the wall where it is desirable to begin the filling. There is no definite uniform point in cavities, at which to begin the introduction of the gold; usually, however, in crown cavities of the molars, at the posterior wall. At whatever point the filling is commenced, the cavity should be so formed that it will retain the first portion of gold introduced; and this may be done by forming a little pit or groove for the reception of the portion first introduced. This is a particular that can not with impunity be neglected. The gold should never change its position after it is pressed to the wall of the cavity; for it can not be adapted to any other point after it is condensed. The end of the roll being placed in the cavity, it is seized far enough without the cavity to form a fold that will extend to the bottom, and protrude from one to two lines beyond the border of the orifice. This fold is pressed firmly upon the preceding portion of gold and adjacent walls. Thus fold after fold is introduced, passed to the bottom of the cavity, and, protruding from the orifice, consolidated firmly, each portion as it is introduced, to the bottom of the filling. This can not be done by the use of the wedge-shaped instrument; it will compress most at its largest diameter, that is, at the surface of the plug.

In no filling, even when the walls of the cavity are parallel, will a uniform density throughout be obtained by perforating with the wedge. The filling would be most dense at the surface, and less so the farther into the filling we go. This method is objectionable for condensing the fillings on the masticating surfaces of the molars; for in the act of mastication the inner portion would yield, and the surface of the filling would be crowded down into the cavity, and the dentine within the orifice become exposed and decay. In proximal fillings this objection would not have the same force. In forcing an instrument of a wedge form into a filling with sufficient force to condense the mass, there would be great danger of breaking a weak wall of the cavity. The principal pressure is lateral, and would consequently come upon the side of the tooth.

In crown cavities of the molars where there is any considerable inward expansion of the cavity, that method of condensing would be wholly inefficient; it would not render the inner portion dense enough to support the surface of the plug, and it would be forced down, and necessarily be loose. In filling the proximal cavities of the incisors, it is very objectionable on account of the great liability of breaking the inner and outer walls, which are usually quite thin.

In preparing the foil for filling, some operators tear off the foil in irregular pieces, and make into little balls or pellets, round and loosely rolled, corresponding in size with the cavity to be filled. These pellets are placed in the bottom, if a crown cavity, and at one side, if a proximal cavity, and condensed with a sharp-pointed instrument, attaching one pellet to an other till the cavity is full. This mode is not so good as that previously referred to, unless the gold is in a condition to weld perfectly; there is no continuous portion from the bottom to the orifice of the cavity; and the outer portions are liable to become detached. Both of these methods of arranging the gold are objectionable in one particular, namely, the irregularity of the leaves or laminæ of the foil; these are placed in the cavity without any regard to regularity, and the consequence is, that without very great care, far less gold will be introduced than by some other arrangement. Far more difficulty is experienced in obtaining a uniform and equal density than when the laminæ are placed smoothly together.

An other method of preparing the foil is to fold it into from four to twelve thicknesses, then cut off strips in width corresponding to the diameter of the cavity. The strip thus prepared is introduced in the same manner as the roll, except that as each fold is inserted, it is placed smoothly against the preceding portion, and kept smooth and free from wrinkles. By this arrangement very little force is required to bring the folds in perfect contact. Some care and skill will be necessary to bring the instrument to bear upon the whole surface of the fold. More gold can be put into a cavity in this manner than in rolls or pellets, unless these are used in very small portions, and condensed very perfectly as they are put in.

BLOCK FILLING.

An other and in some respects far preferable method, is filling with blocks. Some of the advantages of this method over that just described, are the following: the filling can be introduced far more rapidly; and the laminæ, or leaves of foil take a more perfect position in the cavity, and consequently the structure of the filling is better. The form of the cavity should be much the same as that for any other method of filling; there should be some retaining point so situated that the first block, or blocks, can be fixed firmly in place, so that there will be no liability of loosening during the subsequent part of the process. It is important to have such an arrangement, as otherwise it would be necessary to employ an instrument in the left hand to retain the first blocks in situation, till enough were introduced to bind the whole by pressure upon two opposite points in the cavity.

Forming Blocks.—For forming blocks, use any number of foil that may be desired, usually No. 4 or 6, and either lay four to six sheets together, or fold a single sheet into that number of thicknesses; then cut off, from the sheets thus prepared, strips about one third to one fourth wider than the depth of the cavity to be filled; which are then rolled on a small three-sided or four-sided broach—the three-sided is better; and this instrument should be very small; no larger, indeed, than is indispensable for strength. Its sides should be perfectly smooth, and its angles sharp; ordinarily it should not taper, or at least very slightly. For forming the conical blocks, some prefer the tapered broaches, but they can be as well made on the parallel-sided instruments. The strip being taken between the thumb and the index finger, is rolled on the broach equally, till the block or cylinder is large enough, when the strip is broken off. The sizes of the principal part of the blocks should correspond with the sizes of the cavities to be filled. Different sizes and forms will be required in almost all cases. Relatively large cylinders may be employed for the principal part of the filling. If the walls of the cavity are parallel, almost all the blocks may be truly cylindrical; but if there is an underdipping of one or more of the walls, the blocks adjusted to that particular part should be cone-shaped, corresponding to that underdipping. A number of small graduated cone-shaped blocks, of different degrees of density, will be required for completing each filling; as the aperture becomes smaller, smaller blocks will be needed. The cone-shaped blocks are formed, by gradually running the strip back from the point of the instrument as it is wound on; greater or smaller taper can be given to it, as the strip is run less or more rapidly back from the point. The density of the block can be regulated by the firmness with which the strip is held between the thumb and finger; upon which it is well to have a fine silk or India-rubber covering to protect the gold from the perspiration of the hand. There are other methods of forming blocks. They may be made square, by making a great number of folds—fifteen to thirty—and from this, cutting strips as before directed, and then from these heavy strips cutting off the blocks of the desired size, which will then be flat or nearly square. In one respect these blocks are objectionable: the edges, when they have been cut off, are rendered dense by the action of the shears, so that they do not possess the uniform density or consistence of the rolled blocks, and it is impossible to adapt them as perfectly to the walls of the cavity, or to one an other. This objection, however, may be obviated by cutting off the blocks with a very fine saw.

An other method of forming blocks, first employed by Dr. Blakesley, is to roll a sheet of No. 5 foil into a rope, and cut off from it blocks corresponding with the size of the cavity to be filled. These are liable to the same objection as those last mentioned, the shears hardening them, when they are cut off. They are subject to the additional objection, that the folds of foil are not as regular as by either of the other methods. But by proper manipulation, with the gold prepared in this manner, superior fillings may be made. The cavity formed, and the blocks prepared, the next step is their introduction.

Introducing the Blocks.—For placing the gold into the cavity the plugging pliers will be required; the points of which should be curved, so as to make the most perfect approach to the cavity. The points, too, if properly formed, may be used for condensing the blocks. All things being ready, with suitable napkins and guards for the protection of the cavity against the encroachment of moisture from the saliva and breath, the fingers of the left hand should press upon the napkin, and also hold away the soft parts. If there is a very acute angle, a small block should be first introduced with the pliers into the proper position, one end upon the bottom of the cavity, and the other protruding from the orifice, and pressure then be made upon it to consolidate it, and force it into its position against the wall of the cavity. This may be done with the pliers, or probably better with an instrument formed for the purpose. The part of the instrument brought to bear upon the gold should be roughened either longitudinally or transversely, so that a proper surface may be left for the reception of the succeeding portions. The largest blocks are then introduced and consolidated successively as described. The end of each left protruding till the cavity is filled, each portion as it is introduced, should be perfectly condensed. The gold should be filled in faster at the sides of the cavity than in the center, thus being disposed round the walls till it meets at a point opposite the place of beginning; and thus it is adapted to all the walls of the cavity before this is entirely filled, the last portions being introduced somewhere near the center of the filling. As the cavity diminishes by the introduction of the gold, the small and more dense blocks will be required; which should be forced in and condensed, by crowding an instrument down against the side of the cone. Some operators terminate the filling against the wall of the cavity, forcing down the blocks and compressing, as above, till it is full. By this method there is danger of fracturing the tooth, breaking down the wall of the cavity, when the filling is terminated. An other method is to fill up the cavity principally with blocks, and to put in the last part of the filling in the strip, fitted in from the bottom to the orifice.

The objection to this method is, that unless adhesive foil is employed, the portion inserted in the strip is liable to be displaced, and in this way the whole filling to become destroyed.

An other method of arranging this kind of filling, particularly when the bottom of the cavity is irregular, is to make a large, flat pellet, press it firmly into the bottom, and set the blocks upon this for a foundation. By this method there is a more perfect adaptation of the gold to the bottom of the cavity, than by placing the ends of the blocks down upon an uneven surface. After the gold is all introduced, a small-pointed plugger must be passed all over the surface, to consolidate the protruding portions and form a surface to the filling. These protruding portions should be sufficient to make the surface perfectly flush with the border of the cavity; for a depression here is fatal to a complete finish. After the surface is condensed with the fine and large points, it may be rubbed down with an instrument serrated upon the side, and afterward with the coarse file, and then with the fine, etc.

Dr. Badger describes a method of filling a small cavity on the posterior proximal portion of a second molar, the third molar gone. The cavity is formed with a bur drill. A cylinder is then formed in the usual manner, and forced through a series of holes in a drawplate, down to the size of the bur with which the cavity is formed. The block is thus rendered quite dense. The cavity is then dried, and the block forced into it, which it exactly fits, protruding a little from the orifice. This block is pierced in the center with a sharp instrument, and a small dense roll forced into it; and all is then condensed and finished in the usual manner.

Pellets.—Pellets made by rolling fragments or pieces of foil between the thumb and fingers, are used by some operators, and with them they profess to make as good filling as by any other method. They are made of various sizes, and packed into the cavity with sharp-pointed or serrate-pointed instruments. The pieces may thus be very solidly worked together, and a good filling made, provided the pellets are not too large; they should be small enough to permit the point or points to work through them into the preceding portions. Some operators use pellets and crystal gold together. This may do very well, if the adhesive property of the gold is employed; but in that case, either form of the material would answer alone. There can not be as much gold put in by pellets as by blocks well adjusted.

Adhesive Foil.—By this we understand that condition of gold foil in which the leaves unite very readily and very firmly togther. This property of cohesion is possessed, in the greatest degree, by properly manufactured foil, immediately after annealing. Not that annealing imparts any new property to the gold, but it removes obstacles to the manifestation of a principle possessed by all gold under favorable circumstances. It is now about four years since this property was first employed in gold foil for filling teeth. To Dr. R. Arthur is due the credit of first directing the attention of the profession to it. He not only did this, but he entered most fully into the details of the manipulations, instruments, etc., pertaining to this mode of operation. Almost all recently prepared gold foil possesses this property to a greater or less degree; there are methods of preparing it, however, by which it possesses it most fully; all recently annealed foil is adhesive. If the foil is adhesive when we wish to use it, nothing further is required in the way of preparation. But if it is not adhesive—as almost all foil is not, especially if it has been exposed to the influence of the atmosphere—it will require to be made so by some process: there are two, either of which will perfectly accomplish the object.

The one most frequently employed, is that of heating the gold, either in the sheet, in the roll, or in fragments, over the flame of a spirit-lamp, almost or quite to a red heat; if in the sheet, it should be laid upon a piece of wire gauze, and passed over the flame of the lamp for a moment or two; if in the roll, it may be taken in the center with fine pliers and passed rapidly through the flame; if in small fragments or pellets, placed upon a piece of charcoal and a light flame thrown upon them with a blowpipe. The other method is that adopted by Dr. Coates. Into a little platinum pan, large enough to hold an unfolded sheet of foil, are put one or two gills of rain water, to which are added about forty drops of sulphuric acid; and in this liquid the foil is boiled a few moments over the flame of a spirit-lamp. The acid removes all foreign substances from the surface of the gold. Remove it from the boiling liquid, and in a moment it is dry and ready for use, and will be most thoroughly adhesive.

There are different methods of using gold in this condition; but in general the cavity should be formed about as for the other methods of filling, except that to retain the first piece, there should be two or three small pits or holes made for retaining points in the most available position. The first portion of gold should be a little pellet; this forced into these retaining points, serves as a foundation for the remaining portion of the filling. Dr. Arthur's method is, then, to tear off fragments from the sheet, and pass it into the cavity without folding up, and condense it with a fine serrate-pointed instrument, so that it not only unites by cohesion, but it is worked into the surface of the preceding portion of gold; and in this manner portion after portion is introduced and condensed, until the cavity is full. The filling may be commenced in any part of the cavity that is most convenient; in many, as in crown cavities of the molars, at the bottom, and filled to the orifice. In putting in the gold, it should, during its introduction, be kept fuller about the walls of the cavity than in the center; by this means the adaptation will be most perfect to the walls, and there will be no liability of clogging up the center. The gold may thus be built up to any desired extent if the filling is kept dry; moisture is fatal to its adhesiveness.

Others use the adhesive gold in a different manner. To Dr. Blakesley belongs the honor of first detailing the following plan: The sheet of gold may be folded or not at the pleasure of the operator, and then each sheet cut into from two to six strips, and these formed into a loose roll between the thumb and fingers. It may now be passed rapidly through the flame of a spirit-lamp to remove any foreign substance that may be upon it; when it is cut into little blocks or pellets of various sizes; these to be regulated by the size of the roll and the amount cut off. For the introduction of the gold thus prepared, about three sizes of serrate-pointed instruments are required, those having fine points being preferable. As to the sizes of these points, Dr. Blakesley remarks, "they will just enter, respectively, No. 22, 24, and 26 of the wiregauge." A larger than either of these, however, is desirable for many cases. As before, the filling may be commenced at the bottom of the cavity or at one side, if desirable, with a pellet sufficiently large to be set firmly into the retaining points. Then take up the small pellets or blocks upon the point of the plugging instrument, and place them exactly in the desired position, and consolidate them perfectly, building up next to the wall all around higher than the center with the smaller pieces, filling up the little corners and interstices; for which manipulation the smaller points will be required. The gold is then packed in till the cavity is full, when it is finished as usual. An other method is to tear off fragments from the sheet, and roll these up into round pellets, and fill with these, with the same instruments and upon the same principle as above described. But by this method it is difficult to make a perfect filling; the gold is liable to clog in the cavity, and fail in adaptation.

Adhesive gold must be consolidated as it is introduced; for after a cavity is full, it is very difficult then to condense it any more, even though the consolidation is but partial; and much more is this true of nonadhesive foil.

CRYSTAL GOLD.

The form of the cavity for crystal-gold filling, should be much the same as that described for other fillings, except that the same care is not necessary for special retaining points; for the first portion of gold that is introduced into the cavity, as good crystal gold, will attach to the wall of the cavity without any such special retaining points: such a form should be given as to secure the first piece firmly in place. The gold should be cut or broken into pieces corresponding in size to the cavity, so that they will enter freely into it.

The filling may be commenced upon the bottom of the cavity, or upon one of its sides; such a point always being selected as will most effectually retain the gold in place. The pluggers should be of various sizes—the first one as large as can be used in the cavity, and smaller ones for condensing more thoroughly; and all should be serrated with from two to six sharp points, usually four. The blocks may be taken up on the points of the plugger, and passed to their proper position in the cavity, and there condensed. The sharp, serrated point leaves the surface in good condition for the reception of the next piece. The gold should be packed to the walls of the cavity a little in advance of the center, so that its adaptation may be more complete. In this manner, the filling is built up as much as is desirable, if it is kept dry—and unless it is, all cohesion is lost.

The gold, after it is cut up, is put on a piece of

[illegible]

[illegible] The points and [illegible] with the [illegible] have a firmer hold upon the [illegible]

In forming crystal gold into a solid mass, two principles are operative: cohesion acts upon it as potentially as upon gold in any other form, and, in addition, there is the interlacing, or locking, of the crystals with one an other; so that a more perfect union of the different portions of which a filling is composed, is obtained with crystal gold than with foil. Yet good adhesive foil, when thoroughly worked in, attains almost the same condition. With perfect crystal gold, however, some advantages may be secured, that can not be had with foil. The gold will be retained in a cavity that will not retain a foil filling; it is more easily formed into a coherent mass; it can be built out with more ease; cavities can be filled with it that can not be filled with foil at all; and a filling of it is susceptible of a far better finish, with the same labor, than a filling of foil.

It is important to keep the gold perfectly free from moisture, while being introduced and consolidated; for moisture instantly destroys its cohesive property. And the more complete the exclusion of moisture from the cavity, during the process, the better for the success of the operation. The surface of every filling should be consolidated for finishing, before it is allowed to become moist; for, whenever it becomes saturated with moisture before consolidation, it is impossible to make a perfect finish. There should always be gold enough superadded to insure this;

and the consolidation of the last surface should be effected with a rough-ended, not serrated, instrument.

FINISHING FILLINGS.

The method of finishing a filling, and the manipulation, will depend somewhat on the locality of the cavity. When this has been completely filled, and the filling thoroughly consolidated over all the surface, and especially all round its border, the file should be applied to dress off any projecting portion, and render the filling smooth. In consolidating the surface, an instrument should be used, that would not pit it, and the file should remove all indentations. The work of the file, however, should be but partially peformed at first, and the surface consolidated again, with a square-pointed instrument. To obtain the most perfect finish, the surface should be brought to a uniform consistence; and this condition can not be reached by the use of sharp-pointed instruments, nor fully by that of the blunt plugger at the first effort, but by the alternate use of the file, the blunt condenser, and the burnisher. A coarse file should be employed in this part of the process; but when the filling is dressed sufficiently, and in good condition, the fine file should be used, alternately with the burnisher, till a perfectly uniform surface is obtained. In all cases, after the file has been applied, the plug should be washed off with a brush, to remove all detached pieces of gold, before the burnisher is put upon it; and after the fine file and burnisher, the Scotch- or Arkansas-stone or very fine pumice should be employed to remove the filemarks. The pumice may be applied with water on a strip of chamois skin, a piece of linen tape, or a stick of soft wood—the latter being the most convenient, as it can be used with one hand and shaped to suit any place or position.

After the stone or the pumice has accomplished its work, and the filling has been thoroughly washed, a fine burnisher, with a solution of castile soap, is employed to give the finish. The burnisher should be of the best cast steel, and of high temper and fine polish. Considerable skill is requisite to give the best effect with the burnisher; it should pass smoothly and gently over the surface, throughout its whole extent, and in parallel lines, with a pressure neither too light nor too heavy. It should also be applied very thoroughly upon any portion of the tooth about the border of the filling, that may have been cut by the file or any other instrument. Indeed, quite as much, if not more, care should be exercised upon this as upon the plug itself: it should be polished as smooth as the enamel, if possible; for the more nearly perfect it is in this respect, the better will it resist the action of deleterious agents.

This method of finishing gives to the filling a perfect metallic luster; which, under some circumstances, might be objectionable. Two other methods are in use: after the burnisher has been applied, as above, the buff or tape, with rouge, may be employed, by passing it rapidly over the filling till the metallic luster is destroyed, or deadened, so as not to reflect the light as before, thus leaving a very desirable finish; and the other method is, to stipple over the surface of the burnished filling with the end of a piece of hard wood—sandal wood is recommended—charged with finely pulverized pumice. This gives a beautiful, velvetlike surface, and is fine for fillings in the anterior portion of the mouth, where they are exposed to view. Rotten-stone, applied either with the buff or with hard wood, imparts a finish which, though a little different, is finer than any of the others.

For finishing, some operators prefer to cut and polish, instead of filing and burnishing. But neither so good nor so fine a finish can be effected in this way, and it is probable that economy of time and labor, especially the latter, suggested the method. In all cases, the filling should have a distinct and definite margin: the gold should be trimmed off quite up to the border of the cavity, by passing round it a small, sharp instrument, so as to detect and pare down any portion that might overlap the tooth.

For, if overlapping portions are permitted to remain, foreign substances will lodge beneath, and induce decay. Neglect in this particular has occasioned the loss of thousands of teeth that otherwise might have been saved.

The subject of finishing is almost entirely overlooked by very many operators; but by the neat and skillful it is esteemed of sufficient importance to demand as great labor and pains as any other part of the operation.

CHAPTER VII.

CLASSIFICATION OF DECAYED CAVITIES.

THE following classification of decayed cavities in the teeth, though from the very nature of the subject imperfect, will be found sufficiently accurate for the purposes of the dental student and scientifician. It is based primarily on the position of the cavities, and secondarily on the extent of the decay; the *classes* having reference to the former, and the *modifications* to the latter. The *classes* are numbered according to the accessibility of the cavities; beginning with those most easily approached and operated upon; and the *modifications* according to the extent of the decay, beginning with the smallest and simplest in form.

FIRST CLASS.—Central crown cavities in the molars and bicuspids.

1*st Mod.*—Extension of the decay along one or more fissures.

2*d Mod.*—Two decays in close proximity on the same crown, which may be formed into one cavity for filling.

five :—Transverse extension of the decay round or more angles of the tooth, under the terminatio the enamel.

FILLING BY CLASSES AND MODIFICATIONS.

First Class.—Central cavities of the molars a bicuspids. These decays always begin in the depressions on the masticatory surfaces, which are vulne able points, the enamel-membrane folding togethe here, and often being found imperfectly united, s that an opening is left into the dentine: besides, these indentations afford lodgment for foreign substances which may be forced into them in the process of mastication, and there retained, till, becoming vitiated, they produce decay. Examine carefully the extent and the nature of the decay, and the form of the cavity, which, of course, greatly varies. In some cases, the cavity is found with a small diameter and a comparatively great depth, the diameter at the orifice being the same as within; in others, with a diameter larger at the orifice—as occurs in cases in which a considerable portion of the enamel at the depressions on the crown is imperfect. In the majority of instances, however, the diameter of the cavity is much larger within than at the orifice. Sometimes the decay is found to burrow directly beneath the enamel more rapidly than at any other point; as where there leave a slight projection, so as to form, as it were, a shallow groove.

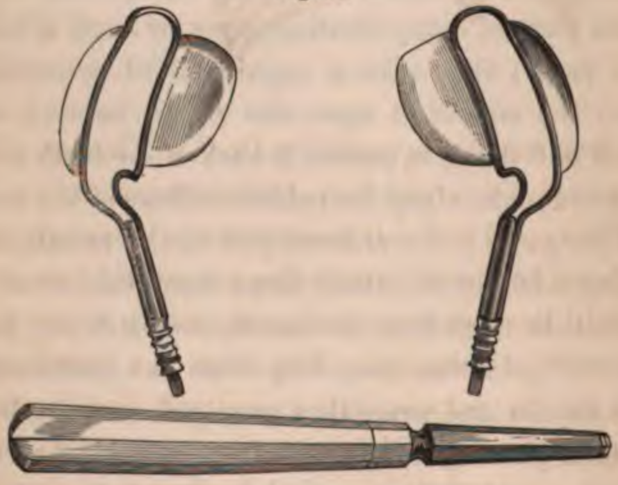
The walls of these cavities will be of various inclinations. If they converge, pits or grooves may be required upon them for retaining points, especially if the enamel be cut away at the orifice to the solid dentine. If, however, the walls, or two opposite walls, are parallel, or but slightly divergent, these special retaining points will not be necessary. Small cavities of this class may be opened up and formed principally with the bur drill; but in large cavities, this instrument is not available. Thus the orifices of the small cavities would be round, while those of the large would be of various forms, determined by the direction of the decay; as, round, square, triangular, elliptical, parallelogramic. Cavities should not be formed much larger within than at their orifices, unless the filling can be consolidated so perfectly that it will not yield in the least under the greatest pressure of mastication; for, if there is any yielding in such cases, under direct pressure, the filling being forced into a larger part of the cavity, withdraws from the walls, leaving an interval coextensive with the depression it has undergone; and thus fluids would be admitted in between the walls and the filling, and the purpose for which this was inserted would be entirely defeated.

Many operators ream the orifices of all the small and medium-sized cavities of this class, in order thereby to make a better finish to the border of the filling. All acute angles in these cavities, especially if they extend to the orifice, should be obliterated, since it is impossible to fill them perfectly. This obliteration can be effected with a miniature chisel, or with the appropriate excavator.

After the formation of the cavity, the next particular is so to arrange as entirely to exclude moisture, whether from the saliva or from the breath. Ordinarily, in operations on the superior teeth, the following arrangement will be sufficient for the purpose: Wipe dry the mucous membrane about the mouth of the duct-of-Wharton; lay directly upon this a piece of heavy blotting paper, or a roll of bibulous paper; then take a napkin folded cornerwise, place the end of it upon the paper, between the cheek and the gum, passing it back of the tooth to be operated upon, along the palatal surfaces of the teeth and the gums to the anterior part of the mouth, and letting a fold of it extend down from this, so as to protect the tooth from the breath, and catch any fragment of gold that may drop from the instrument. The napkin and paper thus arranged, are to be kept in their place by the fingers of the left hand of the operator; and, if the mouth of the duct is kept closed by the paper, a complete exclusion of moisture is secured. In some cases, pressure of the fingers on the napkin over the duct is necessary; in others, the paper adheres to the mucous membrane, and effectually prevents the egress of saliva. The cavity should now be dried by the method heretofore described, and it is ready for the filling.

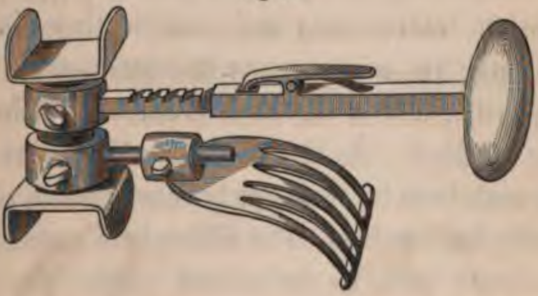
In operations on inferior teeth, more care is requisite to exempt them from moisture. Bibulous paper should be packed in on the mouths of the sublingual and submaxillary ducts, and a roll of paper placed between the cheeks and the teeth. A larger roll of napkin, too, than that used for the upper teeth, should be disposed in the same manner as above suggested, and held in place by the patient with a speculum (Fig. 31), or by the operator and patient

Fig. 31.



with their fingers. Various appliances have been used for holding away the cheek, keeping down the tongue, and retaining the jaws apart; but the method above given, with the addition of a cork to hold apart the jaws, will be found efficient in a majority of cases, and more convenient than complicated appliances. An excellent instrument, however, for this purpose, has been recently invented by Dr. C. C. Thomas. Fig. 32 will give a correct idea of this instrument.

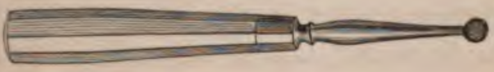
Fig. 32.



Filling with Foil.—If nonadhesive gold is employed, it should be formed into blocks, by cutting from four to eight thicknesses into strips one fourth wider than the cavity is deep, and rolling them on a broach suitable for the purpose, into cylindrical blocks corresponding in size with the cavity to be filled, and varying not only in size, but in form and density. The blocks first to be introduced should be largest, followed by those diminishing in size, till the last portions should be very small, dense, conical rolls. Where there is an inward or an outward inclination of the walls of the cavity, the first blocks should be cone-shaped. For introducing the blocks, the plugging pliers will be required. The first block is taken up with this instrument, and placed against the posterior wall of the cavity with one end on the bottom and the other protruding from the orifice, and there compressed firmly to its place with the appropriate condensing instrument; and, unless there is some special retaining point, it may be necessary to hold it in its position with a second instrument, till the next portion is added. As the successive blocks are introduced, each is to be thoroughly consolidated, so as to be wholly immovable. The filling is to proceed from the posterior walls to the center. After the cavity has thus been filled up to the center, commence in the same manner at the anterior wall, consolidating from there back toward the center again, and condensing the last blocks by forcing in at their side a small sharp-pointed instrument: the final portion introduced will be the small, dense, conical roll already mentioned. The gold being all introduced, a fine square-pointed instrument condenses the projecting portion of the filling till it is perfectly solid, when it is rubbed down with a rough instrument, and then finished with a file, stone, and burnisher, in the manner already described. The particular shape of the surface of the filling will be suggested by the form of the antagonizing tooth. If there is nothing to prevent, the surface should be slightly convex; but if there are cusps striking upon the center of the crown, concave.

For dressing down the filling when a concave surface is required, the instrument represented in Fig. 33 is very efficient. It consists of a spherical file, finely cut, and on a proper shaft or handle; and may be used in the manner of the ordinary bur drill. A variety of sizes, at least four, should be at hand, in order to operate properly upon fillings of various sizes.

Fig. 33.



Adhesive Foil.—For the purpose of filling these cavities with adhesive foil, definite retaining points must be formed in them. The gold, prepared in the manner already described, is taken up with a serrate-pointed plugger, introduced into the retaining point or points, and there fixed; it is then built across from one to the other, and over the floor of the cavity, till this is completely covered, and then up from the bottom to the orifice. When a portion of gold is taken on the point of the instrument, the precise spot at which to deposit it should be selected, and there it should be placed, and, by the first pressure of the instrument, fixed immovably; a few subsequent strokes of the instrument close about the first point of attachment, will be required. These strokes should be close, because if the instrument is lifted up and pressed upon the piece at a distance from the first point of contact, the attachment is liable thus to be broken up. In constructing the filling, we consider it preferable to keep it built up a little higher all around next the walls than at the center, for the reason that a more complete adaptation of the gold can thus be made, than by any other plan. Some, however, advocate the opposite practice; that is, of keeping the filling higher in the center than at the walls, and thus forming an angular space into which to crowd the gold; because they think that the gold is thus kept in more thorough contact with the walls of the cavity; and they object to the other practice, that, to add and consolidate the gold to the center, while the edges are left higher, tends to draw them from the walls. This objection, however, has no force, if the gold is thoroughly consolidated as it is introduced.

The cavity is thus filled up, consolidated, and finished in the usual manner. In adding the last portions of gold, great care should be taken to make a perfect border to the filling. Crystal gold may be very advantageously used as a foundation for adhesive-foil fillings, as it will retain its position perfectly in a cavity, where adhesive foil would not.

Crystal Gold.—The method of filling this class of cavities with crystal gold is very simple. The material should be annealed just before its use, and then cut or broken into blocks corresponding with the size of the cavity to be filled: many small pieces will be required to fill up interstices or angles, and they may be used as large as will freely enter the cavity. The filling may be commenced at the bottom of the cavity, and built up from that to the orifice, the same plan being followed in adapting it to the walls as with adhesive foil, the pieces being passed into the cavity with either the plugging pliers, or a serrate-pointed condensing instrument. Each piece should be thoroughly consolidated before an other is added. For condensing the filling next to the walls, a small double-pointed or wedge-shaped instrument is valuable. In all cases where there is a divergence of the anterior wall, much care is required in order to make a perfect filling; and too much care can not be exercised in perfecting the filling round the border of the cavity. In condensing adhesive foil or crystal gold, the force may be applied almost exclusively in a line with the axis of the tooth; and this is always preferable to lateral pressure.

1*st Mod.*—Extension of decay along one or more crown fissures. In a case of this kind, the central cavity is first to be opened and excavated, according to the principles already announced. Decay in the fissures is in some cases an extension of this central decay, and at the point of its termination there will be found an acute angle; but in others, it will be the effect of an equal attack all along the fissure, or of an extension from some other point than the central cavity. This modification of decay may terminate not only in an acute angle, but also in an expansion.

These decayed fissures should be opened up by cutting away any projecting portion of enamel, and the cavities formed with a small chisel-shaped instrument, beginning at the juncture of the fissure with the main cavity, and cutting down to the bottom of the decay in the manner of a mortise, thus obliterating the entire fissure and the acute angle at its termination—the latter an important consideration. In case there is a very considerable expansion of decay at the termination of the fissure, the bur drill may be introduced into it, and the rest of the fissure cut out, as the character of the decay may indicate.

If blocks are used to fill these cavities, they should be set in and compressed against the end of the fissure, protruding from it sufficiently to admit of a proper finish; and block after block then added, till the fissure is filled up to the main cavity. Where there are two or three of these decayed fissures in one tooth, it may be quite as much as can be done at one sitting, to fill them, the main cavity being left for an other time. In such cases, the filling introduced at the first sitting, should then be consolidated and burnished, so that it may not absorb moisture till the main cavity is filled, as already described. Much care should be exercised to prevent the gold from overlapping the enamel at the sides of these fissures. In filling this modification with crystal gold or annealed foil, it is better to begin at the bottom of the cavity and build up to the orifice, first completing the fissure, as we have already described, and afterward the main cavity.

2d Mod.—Two cavities on the same crown in close proximity. The thickness of the portion of tooth intervening between two cavities on the grinding surface of the same crown, is determined by the extent of the decay; and the form of it, by the form of the cavities; and these two qualities will suggest the method of operation. If this intervening portion is thin throughout, and devoid of vitality, it should be cut away, and the two cavities formed into one; but if it is thick within, though it may be thin at the surface, the cavities should be filled separately. In some cases it is proper to leave a part of it standing, as a sort of ridge between the cavities, though not as a definite partition; in which cases, the filling would be begun as in two cavities, and finished as in one. In no case, however, when the tooth is living, should this intervening portion remain, if its vitality is gone. The details of the process of filling crown cavities, have already been indicated.

SECOND CLASS.—Buccal and palatal cavities of the molars and bicuspids, and labial and palatal cavities of the canines and incisors. In the molars, this class of decay begins either at the margin of the gum, in the form of a transverse groove, or along the vertical depression on the buccal surface of the tooth, or at its termination. These groovelike decays, extending along the side of the tooth at or near the margin of the gum, are ordinarily not very deep; but they burrow considerably under the enamel, particularly at the side next the grinding surface. In preparing these cavities, the projecting portion of the enamel must be mostly cut away, leaving them but slightly larger within than at the orifice. These grooves, at their ends, are shallow; but in their preparation for filling, they should be cut as deep at the ends as elsewhere, and, when the main part of the cavity is comparatively shallow, deeper.

The method of introducing gold in the form of blocks into these cavities, is, to set in the first block at the posterior part of the cavity, and consolidate it, and so one block after an other, till the cavity is nearly full; and then proceed in like manner with the anterior end, back toward the middle, the blocks, of course, being permitted to protrude sufficiently for the purposes of a finish. For filling with crystal gold or adhesive foil, the method is, to form pits at the end of the groove, into which the gold is consolidated, and built across from one to the other, and then up from the bottom to the orifice, when it is finished as usual. Care is requisite to prevent the gold from overlapping the tooth.

Those cavities of this class, which are formed in the depressions of the buccal portions of the teeth, are more easily filled. Often a simple round cavity is formed, which may be entirely prepared with a bur drill. The method of filling these cavities will be readily inferred from the remarks before made. If, however, the decay extends along the depressions, making a groovelike cavity, this should be filled by commencing the introduction of the gold at that side of the cavity next the gum.

1*st Mod.*—Decay at or near the neck of the tooth, and partially or wholly overlapped by the free border of the gum. In this modification, the gum is a great obstacle to the various steps in the process of filling: it is liable to be wounded and to bleed at every touch; it exudes mucus constantly; and it conducts saliva to the parts with great facility. To obviate these difficulties, the gum must be removed somewhat from the cavity, before the filling is practicable. This removal of the free margin of the gum, may be made either by cutting away, or by pressing away with pledgets of cotton or other appropriate substance placed in the cavity and overfilling it, so as to induce a partial absorption of the gum pressed upon, in a few days. The former method, however, accomplishes the object at once: some good hemostatic, or cautery, as nitrate of silver or chlorid of zinc, is all that is then necessary to render the filling immediately practicable. By means of the cautery, the exudation is checked—which, where there is much mucus eliminated, is an important item—and also such a surface is given to the part, that it will not so readily conduct the saliva. It is, perhaps, preferable in many cases to cut away this free margin, so that it shall not be in contact with the filling after the operation is completed.

After this preparation, the cavity is formed and filled as usual. The napkins and paper are to be placed in the precise position, and carefully retained there. Two or three thicknesses of paper should be laid on the gum up to the margin of the cavity, and kept there during the process of filling, so as to exclude all moisture. In filling cavities of the buccal portions of the *dentes sapientiæ*, peculiar difficulties are met with: the decay is frequently found two thirds covered by the gum; the muscles of the cheek, thick and rigid, lie close against the side of the tooth; and, in most cases of this kind, the view, at best, is but partial. In operating upon these cavities, an instrument for holding out the cheeks is required. (See Fig. 29.)

THIRD CLASS.—Anterior proximal cavities of the molars and bicuspids. This class of cavities in teeth with short, broad crowns, takes place at their necks; but in those with long crowns, and with a diameter less at the neck than at the masticating surface, it begins at some distance from the neck, toward the crown surface, or at the first point of contact of the crowns; in which case the teeth ordinarily require separation. The method and extent of this will be determined by circumstances. If all the neighboring teeth stand in contact, it can not be accomplished by pressure; but, if a tooth has been extracted in the vicinity, or there are natural spaces between the others, it can be, either in whole or in part. When, however, the teeth stand close together, they must in such case be separated wholly with the chisel and file. If but one is decayed, the cutting should be exclusively from that. If two are alike affected on their proximal surfaces, it should be mostly from the posterior surface of the anterior tooth, and should leave a space in the form of a V. There should be no shoulder left at the neck of the tooth, but the cut surface should be plain from the crown to its termination at or near the neck. The interval should be large enough to enable the operator to manipulate with facility, and to see as directly as possible into the cavity.

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the outside of the cavity's upper

wall; and in such case no cutting in that part is admissible.

Great pains must be taken to arrange and dispose the napkins and bibulous paper so as to protect the cavity from moisture during the process of filling. A roll of paper should be placed on each side of the tooth, and on the paper the napkin, properly folded, should be laid, and kept in place by the operator with the left hand, or by the patient with the speculum. The gum between the teeth is liable to secrete mucus enough to moisten the work, or to be touched by the instrument so as to bleed; and to obviate these difficulties, a small piece of soft wood should be wedged down between the teeth below the cavity, so as to press the gum out of the way, and thus provide against both contingencies.

In addition to these preparations, it will, in many cases, be necessary to place a cork between the jaws, in order to keep them apart during the operation. By this arrangement the mouth being propped open, the soft parts are sustained more in repose, and so less saliva is eliminated from them to interfere with the work.

With this preliminary, the cavity is ready for the filling, which is introduced, if in blocks, as before detailed, beginning with the cervical wall. The caution may here again be urged, not to let the gold overlap the tooth, particularly at the cervical wall. In filling with crystal gold or adhesive foil, special retaining points will be required in this wall, two being generally sufficient, one toward the outer, and the other toward the inner lateral wall, on which walls, too, grooves may be made, if the walls are thick enough to admit of it. If, however, these walls are not parallel, and will not admit of grooves, the crown and the cervical wall should be so shaped as to retain the filling. But in some cases the attachment of the filling is made entirely at the cervical wall; and best by means of three pits, bored with the square-pointed drill, at different angles, and in such directions as not to interfere with the pulp. This kind of attachment will serve only for adhesive gold, which is to be very thoroughly consolidated into the pits, and built very firmly across from one to the other, making little projections, which are so many anchors for fastening the filling.

2d Mod.—Decay involving a portion of the masticating surface. There are two methods of filling this modification. One is, to cut down the tooth or the projecting angles, and make a plain, oblique border to the cavity, and then fill up flush with this border. The filling will thus exhibit a single, uniform surface, at a considerable angle with the axis of the tooth. When a portion of the crown breaks down in consequence of proximal decay, it is toward the center of the tooth; usually the inner and outer corners remain. If these projections are feeble and liable to be broken away, they should be cut down, and the cavity filled as before described. If, however, they are firm, they may remain, and the cavity, properly formed, may be filled so as almost to restore the tooth's original form. This method is seldom applicable to the bicuspids, but is often available in filling the molars. Nonadhesive foil is not adaptable to this kind of filling, as it can not be built in so as to withstand the pressure of mastication. A free space is to be left between the filling and the adjoining tooth.

FOURTH CLASS.—Proximal cavities of the incisors and canines. If the teeth are not in a corroded condition, and the file is not required by the strength of the decay, separation may be made by pressure, if there are no forbidding circumstances; but if the cavity is large, and the walls are thin, separate with a thin chisel and file. Much has been said as to the manner of separating these teeth, some recommending that the separation be larger at the palatine part than at the labial; others, that it be larger at the points than at the necks of the teeth; some, that a shoulder be left at the necks; and others, that there be no shoulder at all. In making these separations, however, the operator must be governed somewhat by circumstances, no general rule being applicable to all cases. The form of the teeth and the extent of the decay will modify the form of the space between them. If the inner wall is thin or broken away, it should be cut off more than the outer; in which case, the palatine portion of the separation will be the largest—as, indeed, some prefer to make it in all cases, performing then the remainder of the operation from the inside. But this is a disadvantageous method; for the cavity is more difficult of access from within than from without, and the view is less perfect, unless aided by a mirror, the use of which is always attended with inconvenience: it is preferable to make the separation so that the principal part of the work can be done from the front.

In some cases, separation will be larger at the points of the teeth than elsewhere; as, where there has been a partial fracture at the points. In cutting away, to make the separation, no shoulder should be left at the neck of the tooth; any projection of that kind is always objectionable: it is not protected by the filling; foreign substances lodge upon and adhere to it, and, becoming vitiated, render it very liable to decay. The cutting should always extend entirely beyond the decay, but only far enough to make a perfectly plain border to all the cavity, and should terminate without any projection. It is highly important, in separating the anterior teeth, to make as little alteration as possible in their form. But the preservation of the tooth should not be jeopardized for the sake of maintaining the integrity of its natural form. The first consideration should be, to obtain a space sufficient for the purposes of a perfect operation; the second, to have the walls and border of the cavity in such a condition that an efficient filling can be made; and the form and beauty of the tooth may be reckoned the third consideration.

The excavation of these cavities requires very delicate and skillful manipulation, since they are very readily injured by cutting too much or at a wrong point. All decayed and discolored portions must be entirely removed, as well for the appearance of the tooth, as for the permanency of the operation; after which, the cavity is to be formed with great care. At the point of the tooth the dentine often has all been displaced by decay, leaving only the two plates of enamel joined at the edge, and thus forming an acute angle, the obliteration of which is always attended with risk, unless great care is exercised; and it is very difficult perfectly to fill a very acute angle. The inclination of the inner and the outer wall of the cavity will depend on its size: when this is small or medium, they may be parallel, or, if necessary, slightly divergent; but when large, it is better not to cut much of the healthy dentine from them, lest they be thus weakened. Small grooves, however, are admissible on these walls, near the bottom of the cavity, when they incline to the center, and are generally, in such case, to be preferred to pits. More cutting is allowable on the cervical wall than elsewhere, as there is no danger here of weakening the tooth by excavation. In filling with adhesive gold, we may, if necessary, rely exclusively on this part of the cavity for the retention of the plug; and the best method of preparing it is, to make two or three little pits in it at different angles, with a fine, square-pointed drill. An other method is, to form two pits, and make a groove from one to the other. Some operators prepare these cavities by making pits in each of the walls. This, however, is unnecessary, if the cervical wall is properly prepared.

The cavity being prepared, the rolls of bibulous paper or napkin should be placed on the gum inside, and between the gum and the lip; and if the former has been wounded between the teeth, or if it eliminates mucus, a small piece of soft wood or of rubber should be crowded down upon it below the cavity. The gold, prepared as already described, should then be introduced with a small plugger serrated with four points, and somewhat flattened about a line above the point, so as to be freely used when introduced into the cavity. The gold is taken up on the point of this plugger, and condensed in the pits of the cervical wall; which being completely filled, and the gold extending from one to the other, the foundation is ready for the remainder of the filling.

Great care is requisite, in packing the gold into these cavities, perfectly to adapt and adjust it to all their points, so as to insure its thorough contact with every part of their interior. If the form of the tooth has been measurably retained, and the border of the cavity is even, the surface of the plug should, when finished, be slightly convex; and, in introducing the filling, reference should be had to this particular. The cavity may be filled up two thirds of the way to the wall next the point of the tooth, and then its remaining portion filled from the point back to the preceding filling; or, what is probably better, begun at the bottom and filled to the surface, and then finished in the usual manner.

For filling these cavities with nonadhesive foil, the special retaining points already described are not required; but the cervical wall of the cavity is slightly cut under, and the lateral walls so shaped as to secure the filling in place. These cavities are in some cases very difficult to fill with nonadhesive foil, whether in the form of blocks or otherwise, especially where they are large, with the walls inclined to the center, and the tooth bone friable. To force a wedge-shaped instrument into these fillings, for the purpose of condensing them, is inadmissible, since there is thus great danger of breaking the walls of the cavity, and, in many cases, of moving the filling from its place.

1*st Mod.*—The palatal wall broken away. Fractures of this kind assume different forms; sometimes triangular, extending from the border of the cavity toward the center of the tooth, and terminating in an acute angle; and sometimes the border of the cavity is broken away irregularly, or so as to form part of a circle. When a triangular notch is broken out of the wall, the operation of filling may be performed in one of two ways: If the portions of the wall remaining at each side of the fracture are thick and firm, they may be left, and the cavity may be filled up flush with both the proximal and the palatal surface of the tooth, the latter being thus restored with gold to the extent of the fracture or notch. If, however, the remaining portions of the wall are frail, they should be cut away till a border is reached sufficiently firm to sustain the filling. Such cutting will leave the notch of a circular form, and, in many cases, will remove almost the whole of the inner wall of the cavity. As the decay extends toward the center of the tooth, owing to the concavity of its palatal surface, this wall becomes very thin; but, in all cases, the excavation should be such as to leave a definite wall, though it be but slight, all along that part of the cavity. In such a case, good retaining points must be made in the cervical wall, since the permanency of the filling will depend almost entirely upon these.

The surface of the filling, when finished, may be slightly convex from one lateral wall to the other; the palatal portion of the surface, from the point of the tooth to its neck, will partake of the curvature of the border of the palatal wall; but the anterior portion will be only flush with the anterior wall. Much care is requisite to give these fillings a perfect finish, on account of the irregularity of surface, this, in many instances, being both convex and concave. As a material for filling these cavities, adhesive gold is much to be preferred. Indeed, in many of them, it is impossible, with nonadhesive gold, to make a perfect filling, because they have no general embracing form. In such cases, the filling should be introduced from the palatal side of the tooth.

2d Mod.—The labial wall of the cavity broken. The fractures of this wall are of various forms, and of extents corresponding with the friability of the enamel. There is sometimes the triangular notch, extending far toward the middle of the tooth; and sometimes there are two or three small notches; and still in other cases, almost the whole of the wall will be broken away from the point to the neck. When there is simply a notch in the enamel, it is important for the appearance of the tooth, to fill it up; and when there is any prospect of success, the remaining portion of the wall being retained, the operation is to be performed as already described for the palatal wall. It will, however, in many cases, be necessary to cut away part of the remaining portions of the wall, leaving the general form of the border somewhat circular; though the notch form, in some instances, is not wholly obliterated.

In filling this kind of cavity, it is desirable to restore as much as possible the form of the tooth. The filling should be built out from the border of the wall almost to a line with the tooth's original proportions, so that the whole surface of the filling will be convex; and should be finished with great care, the stipple finish being preferable for that part exposed to view.

3*d Mod.*—The cavity extending almost to the point of the tooth, and terminating, or cropping out, at the surface. In the preparation of this cavity, that part next the point of the tooth, should be cut in enough to form a definite wall there, and to give room for sufficient thickness and strength in that portion of the plug. Many operators attempt to fill this kind of cavity without such precaution, terminating that part of the plug in a thin, sharp edge. The method is very objectionable; for this thin edge will get more or less separated from the tooth, and foreign substances will be forced under it, and, becoming vitiated, induce decay. Indeed, a defect of this kind is a sure precursor of the destruction of the filling. The introduction and finish of the filling in this kind of cavity are the same as first described for this class; and the admonition may be repeated, that there be left no thin overlappings of the filling, that may become changed in position.

4th Mod.—The cavity large, and the lateral walls thin and friable. In this kind of cavity, the dentine is almost entirely removed from the lateral walls, leaving little else than the enamel after the excavation of the decay. These walls will, of course, admit of no cutting for the purpose of giving them a more desirable form. The cervical wall must be shaped with special reference to a retention of the filling, to consolidate which the requisite pressure must be applied almost exclusively toward this wall. It requires extreme care to condense the gold in cavities of this kind, and adapt it to the lateral walls, without fracturing them; and various methods have been suggested to prevent such an accident. Pluggers with very fine points are recommended, as consolidating the gold with much less pressure than would be necessary with large-pointed instruments. But it has been maintained that a perfect adaptation of the gold to the inner parts of these walls is not important, provided the adaptation at the border is perfect. It is certain, however, that a filling thus imperfectly adapted, is not so good as though the gold were in contact with all points of the cavity; and besides, the liability of fracturing the wall, is just as great in consolidating at the border as within. The walls may be sustained by enveloping the tooth to the borders of the cavity with some material perfectly adaptable to it, and capable of resisting the force applied in the process of consolidation; as, gutta percha or plaster of Paris. If the former is employed, it should be softened by warming, moulded upon the tooth, and then permitted to harden. The hardening may be facilitated by throwing cold water on it from a syringe. It is then to be trimmed even with the border of the cavity, so as to admit the filling. If plaster of Paris is used, it should be the best article. Yet gutta percha is to be preferred. But a better protection than either may be made of cheoplastic metal, taking an impression of the tooth, and from that moulding the shield; and this material is always to be recommended in extreme cases. In these fillings, when the enamel is clear and translucent, the gold will be visible through it. To obviate this difficulty, some appropriate substance may be placed between the outer wall and the gold—some substance that will restore the natural color of the tooth. Quill, horn, paper, and asbestos have each been employed for this purpose. Horn is, perhaps, the best material, as it can generally be selected of a suitable color. A thin lamina of this may be obtained by pounding a piece of the horn for a few moments, till a layer is detached; which may then be dressed down to the proper size, softened in warm water, and placed in the cavity next to the outer wall, yet so as not to extend quite to the border. The presence of this substance makes the operation of filling a little more complicated; but the horn, being softened, is easily pressed to the side of the cavity and conformed to it; and it may be made to retain its place, when first introduced, by touching it at one or two points with some adhesive material; or it may be made very soft, adjusted in the cavity, and then conformed completely to the wall by a temporary filling of gutta percha, which, after having chilled and stiffened, may be removed, leaving the horn thoroughly adapted and ready for the gold.

FIFTH CLASS.—Posterior proximal cavities of the molars and bicuspids. These are separated like anterior proximal cavities, except that, ordinarily, to open them up, more is to be cut from the tooth, on account of the greater difficulty of approaching and inspecting the cavity. The same general principles are applicable to the opening of this class of cavities, as to that of the third class, except that pressure can not be as frequently employed, since the cavity will not be as well exposed by this as by cutting, nor rendered so easy of approach. Indeed, in operating on these cavities, the use of the mirror is often necessary, it being impossible to obtain a direct view into them, after having cut away all that it is admissible to remove. The accessibility of these cavities will depend on circumstances; such as the location of the tooth, its inclination, the size of the mouth, the flexibility of the muscles, and the ability of the patient to open the mouth and keep it open. Generally, in operating on these cavities, for the removal of decay, the formation, and the filling, curved instruments will be required; but their curvature should not be greater than the necessity of the case demands.

The cavity, during its preparation, must be frequently examined. Its general form, and the size, kind, and location of the retaining-points will be the same as in class third. The lateral walls, if the cavity is not too large, should be made parallel with each other; the undercutting at the crown wall will be less than in anterior proximal cavities; and the cervical wall should have the same general form as in other cases. In this latter there should be made, at different angles, pits for retaining-points—three, if the tooth is a molar, and two if a bicuspid. For making these pits, Merry's drill will be found more convenient than any other instrument.

Preparatory to introducing the filling, the same appliances should be used to protect the cavity from moisture, that have been indicated in modification first of class third. Crystal gold makes a better beginning for these fillings than foil; and hence the retaining-points should be filled up with it, and an attachment made from one to the other; on which foundation adhesive foil may be built, almost up to the crown wall of the cavity, and then the remaining portion filled from the bottom to the orifice. These fillings should have a single plain surface, which will be at a greater or less angle with the axis of the tooth, according to the greater or less portion cut away in the separation. It is impracticable to build these fillings up as some of those in the anterior proximal cavities may be, because of the difficulty of thoroughly consolidating and finishing their proximal portions, especially near the neck of the tooth; though the difficulty is somewhat obviated by placing a piece of polished metal, of the proper thickness, back of the cavity, against the adjoining tooth, introducing the filling, and consolidating it firmly up to this piece of metal: the lost portion of the crown being thus restored, the metal is then removed, and the filling dressed off and finished in the manner described heretofore. The labor, tedium, and difficulty of manipulation are increased the farther back in the mouth the decay is situated. The modifications of this class are the same as those of the third class of cavities, and, except the second modification, are susceptible of the same methods of filling.

Special Cases.—The first case that we shall consider here, consists in a complication of proximal decay with decay on the buccal or palatal portion of the tooth, thus undercutting one of the crown angles.

Sometimes these decays are on both sides, in the form of transverse grooves, meeting at the corner of the tooth. In such cases, if the pendent crown angle of the tooth is firm and strong, the cavities may be formed in the proper manner, and filled without interfering with the masticating portion of the tooth at all; but, if the pendent portion is friable, it should be cut away, and the corner built up with gold. The method of forming the part to be filled will depend on the extent of the decay. When this is large, a greater number of retaining-points will be required than when it is small; and these should be located at such parts as will make them most tenacious of the gold, and least subversive of the strength of the tooth. The filling may be built up so as to restore the original form of the tooth, thus presenting three surfaces, the proximal, the buccal or palatal, and the masticatory; or, it may be made with a single slightly convex surface, adapted and finished most completely at all its borders. This kind of filling can be made only with adhesive gold.

The palatal portion of the crown broken away, leaving the outer portion standing—nerve not exposed.—The tooth, in such case, is decayed away so that the floor of solid dentine is near the margin of the gum, the labial third of the crown still standing. The decay having been all removed, four or five little pits should be made on this floor, as near its circumference as practicable; and a small groove may be cut from one of these pits to an other all round near the edge of the floor. Then two little pits should be made at the base of the standing portion of the crown, if they can be, without interfering with the pulp, provided this is still living. The decayed part thus prepared, a sufficient shield, in the form of paper, folds of napkin, etc., is to be thrown round the tooth, to protect it against moisture during a protracted operation: in this particular great care is necessary.

For building up a crown of this kind, only adhesive gold can be used; and this should be of the best preparation, and in the most perfect condition, since it is important that the different portions of the filling be most thoroughly united. The instruments employed in the operation should be of the best kind and in the best condition, the serrate points being definite and sharp, though not too long: those with four, six, or eight points may be advantageously used for packing the gold. But care must be exercised lest these fine points be turned; for when that is the case, the instrument is liable to displace the portion of gold, and thus break up its first attachment during the process of consolidation; and when this is broken, the piece of gold can not again be made to adhere as perfectly as before.

With every thing thus in readiness, the retaining-points are all to be filled, the gold extending from one to the other; which is then to be built all over the bottom of the part to be restored, projecting a little beyond the periphery, and being perfectly consolidated there, and kept somewhat higher round the border than in the center. The gold should be built on in this manner till the crown is large enough, after dressing, to give the desired size and form. In finishing up, the aim should be, to restore as perfectly as possible the lost form of the tooth; the masticating surface, the lost cusp, the antagonism, and all. The adaptation of the gold, too, to the standing portion of the crown should be most complete; imperfection in this respect impairs the appearance of the work, and jeopardizes the security of the operation.

Occasionally the crown of a molar tooth is found decayed off all round, almost to the margin of the gum, the pulp having previously receded so as not to be exposed. It is, in such case, desirable to restore the lost portion of the crown, and make a masticatory surface such as shall antagonize properly with the teeth of the opposite jaw. As yet, there is no other method of accomplishing this, than by building it up with gold—adhesive gold foil or crystal gold. In the preparation for this crown of gold, the edge should be dressed smooth and even all round the tooth; then six or eight deep pits should be made at different angles about on the base thus prepared;

and they should be bored with a drill larger than is commonly used for retaining-points. These pits may be slightly enlarged within. The method of building up the crown is just the same as that described for building up part of a crown, the pits being first filled, then joined together, and the gold extended all over the part to be covered by the filling. In extending the gold from a retaining-point or points, it is necessary to build up to a considerable thickness above the orifice of the pit. The portion of gold extending along on the tooth from the pit, should be quite thick and firm, so as not to curl up from its position, on the addition of subsequent portions. Every particle of gold, indeed, should be so manipulated, that it will securely maintain its first position. The permanency of the operation will depend very much upon this precaution. The gold should extend somewhat beyond the circumference of the tooth all round, in order to a thorough adaptation and finish.

The foundation thus prepared, and kept free from moisture, the crown is easily built up by the ordinary method of packing the gold. Any desired shape can be given to this artificial crown; but, of course, that which most nearly resembles the form of the natural crown, is in all cases most nearly perfect. The masticating surface of this gold crown is to be formed from the indications given by the antagonizing teeth. Such crowns will wear for years, and perform all the functions of the natural organs. Artificial crowns of this kind have been attached to the tooth, by screwing into the pits small pieces of gold wire at different angles, and then building up round and between them with the gold foil, on the principle already described, thus making these wires serve as so many anchors for fastening the work. This, however, is a less efficient method than the one first described, since there is no cohesive attachment of the foil to these gold anchors, and it is retained in place only by the mechanical arrangement of the wires; but by barbing or roughening them, or giving them abrupt curves, they may be made to retain the crown well, if it is thoroughly consolidated and united. But the method of anchoring with foil, as before observed, is always to be preferred, since by this there is a welding of the entire mass, and an anchorage, too, quite sufficient in all cases to retain it in its place.

Filling large cavities on the labial surfaces of the superior incisors.—These cavities are usually superficial, and frequently coextensive with a considerable part of the surface of the tooth. A method of filling them, somewhat novel, though not without merit, has recently been introduced to the notice of the profession by Dr. Volck, it having been first suggested to him, however, by Dr. Maynard. It consists in filling up the cavity principally with a piece of enamel, as near the color of the tooth as possible. The cavity, when nearly round, should be formed with a wheel bur of the proper size; and after having been thus reamed out, a slight undercutting should be made all round with an excavator. Then a piece of enamel being selected, it is dressed to a proper thickness, which should be slightly greater than the cavity's depth, and to a perfectly circular form, its size being such as to let it drop, with a little play, into the cavity, and the edge of it being beveled from without. For fastening this in the cavity, roll a strip of several thicknesses of gold foil round its edge, and add as much as can be forced in with it; set it all in place in the cavity, and then condense the gold down into the groove all round with a thin-pointed plugger, more gold being added, if necessary, to fill the groove completely full. Afterwards, with the file, stone, and burnisher, dress off the whole to a proper level with the surrounding tooth, finishing very carefully with the burnisher. The unsightliness of a large gold filling on a front tooth is thus obviated, no metal except that composing the ring of attachment in the groove being exposed to view. It is a beautiful operation, and one whose successful accomplishment will require considerable constructive talent and skill.

CHAPTER VIII.

PATHOLOGICAL CONDITIONS.

HITHERTO, in our consideration of the treatment of caries, we have postponed the subject of the vitality and pathology of the teeth altogether. It now remains to describe the diseased conditions to which the teeth are subject, and the treatment which those respective conditions indicate. This is an important department of the practice, since upon skill in this, as well as upon the manner of performing the work, the success of the operation depends.

Premising that our remarks on this branch of the subject are predicated on the fact admitted, that the teeth possess vitality, we proceed to consider the pathological conditions to which, in common with all organic matter, they are liable. There is but one diseased condition of living dentine that presents any considerable difficulty in the ordinary operation of filling teeth, and that is, inflammation, or exalted sensibility. This condition was referred to in the remarks on the treatment of caries, as being one that most generally accompanies decays of the teeth. Whether or not this affection is real inflammation, is a point that has been considerably controverted; and the assertion has been made, that it is of no consequence whether it is or not, provided we understand the true method of treating it. This, however, is not to be so readily conceded; for the confession that we do not know what to call a thing, generally implies an ignorance of its character and phenomena: while the term *inflammation* conveys a definite notion, the phrase *exalted sensibility* is very vague in meaning. That it is true inflammation, is the opinion of our best dental writers. The dentine is endowed with the functions of absorption, nutrition, and secretion—characteristics that always imply a susceptibility of inflammation. In inflammation of the soft parts, there are present various indications; as, pain, redness, swelling, and increased heat. But in dentine, on account of its peculiar structure, all these indications can not be manifested: for instance, redness, since the red globules do not circulate through it; nor swelling, since the structure is too dense; nor perceptibly increased heat, since the circulation is of too low a grade. But, one of the most definite indications of inflammation, namely, exalted sensibility, is present here in all its force. And there are various other circumstances that indicate this condition to be real inflammation: the same irritating causes that induce inflammation in the more highly organized parts, occasion it in the living dentine; this condition of the teeth is always affected by a general inflammatory diathesis, and their sensitiveness, when there is this general tendency to inflammation, is always increased, and local treatment in such case will commonly be inefficient; a modification of such a condition of the system produces a very corresponding change in the affected teeth; and those remedial agents which are employed in the topical treatment of inflammation elsewhere, are successfully used in the treatment of inflamed dentine. From all these circumstances, the conclusion is almost irresistible, that this affection of the teeth is a real inflammation.

As it has been already remarked, the only definite and direct indication of inflammation of the dentine, is exalted sensibility; though this is not an immediate consequence of that condition, independent of external circumstances; for the pain resulting directly from inflammation in the soft parts, is not experienced here, by reason of the low grade of vitality and the feeble circulation. But the teeth, in a state of inflammation, will suffer pain when subjected to sudden variations of temperature, whether induced by the air, by fluids, or by any hard substance; and when subjected to the influence of agents that irritate the nerve-tissue anywhere, such as acids, some alkalies, salts, and sweets. In regard to degree, extent, and location, this affection exhibits a variety of manifestations; in degree, from the most mild to the most intense—sometimes fixed at a uniform pitch of pain, and sometimes passing through the gamut of torture up to the most acute anguish. The character of the affection is modified by differences in the organic structure of the teeth, those most vascular and most highly organized being most readily and most extensively involved; and therefore the teeth of the young are generally more liable to it than those of the old. So, too, persons of a plethoric or a strumous habit, as well as those in a febrile condition, are peculiarly predisposed to this affection. Sometimes irritation or disturbance of other organs of the system, sympathetically or secondarily induce inflammation of the dentine. Uterine irritation frequently does so; and hence, during pregnancy or a protracted suppression of the catamenia, the teeth are very liable to be thus affected, and, if decayed, to become very sensitive.

Inflammation of the dentine will sometimes be exhibited in various degrees in different teeth in the same mouth at one time. This is owing to differences in the organic structure of teeth developed at different periods of life, to differences of their location in the mouth, and to differences of exposure to those agencies which are apt to induce the condition.

As to the extent of this inflammation, it may be confined to a thin lamina of bone immediately beneath the decomposed portion, or may extend deep into the body of the tooth, and, indeed, in some cases, pervade the dentine of the entire crown. This latter extent, however, it is not likely to have, unless it is the result of a general predisposition: if it is produced by local causes, it will not, in general, penetrate very deeply into the dentine. Most commonly, the greatest sensitiveness is at the union of the dentine with the enamel; but, sometimes, it is confined to a small point within the cavity, either because there is a concentration of nerve-fibrils there, or because there has been a determination of the irritating influences to that point—the former being the most probable cause. The greatest sensitiveness, as already remarked, is generally at the surface of the dentine, because that is the termination of the nerve-fibrils which ramify the dentine, and wherever nerve-fiber terminates, there always we may look for exalted sensibility. Hence it is, that decay of the teeth is often found to be more sensitive in its incipient stages, than when it has become more advanced.

Treatment of Inflamed Dentine.—There are several methods of treatment that might be employed to remedy this condition. In many cases, where time and circumstances will permit, a removal of all irritating agents from the affected parts, will enable nature alone to effect a restoration to health. All decomposed dentine is to be cleaned from the cavity, every exciting influence in it withdrawn or neutralized, and the cavity itself perfectly filled with some nonconducting material, so as entirely to exclude all foreign substances. This material may be gutta percha or Hill's Stopping;—and this, in the property of nonconduction, is superior to any other;—or, in some cases, it may be tin or gold; but, when either of these is employed for the purpose of such temporary filling, some nonconducting substance should be placed between it and the sensitive dentine. The length of time necessary for a restoration of the affected part, under this treatment, will be much varied by circumstances. The cases susceptible of this kind of treatment are those in which there is no constitutional predisposition, in which the vitality is strong, and the recuperative power vigorous. When the temporary fillings are made of metals, the patient should be careful to protect them from sudden changes of temperature. For such fillings, in case they are required but for a short time, a lock of cotton saturated with a solution of gutta percha and chloroform, may be used.

But, in cases in which the vitality is low, the affection chronic, the exciting cause highly irritating, and the general diathesis inflammatory, nature, unaided, will not effect a cure. In such circumstances, therapeutic treatment is indicated. The agents employed in topical treatment may be divided into two classes: first, resolvents, or those which have for their object an entire restoration to health of the part affected; and second, escharotics, or those which have for their object the death of a portion or all of the diseased part. The former class of agents is of course preferable, when their object can be promptly accomplished by their use, and especially preferable to those agents which endanger the vitality of the whole tooth. In very many cases in which topical applications are indicated, constitutional treatment is also required; and this should be of an antiphlogistic character. The immediately adjacent parts, too, as the gums, the mucous membrane, etc., should be carefully regarded. Indeed, treatment of the gums by counter irritation, depletion, and various preparations, such as the conditions may indicate, will often be found prerequisite to a successful treatment of sensitive dentine by topical applications.

There are very few agents used simply as resolvents. The properties characteristic of this class of agents are tonic, stimulant, sedative, and astringent. Tincture of capsicum may fitly represent the stimulant, Peruvian bark the tonic and astringent, gum myrrh the tonic, and opiates the sedative principle. Astringents, stimulants, and sedatives all tend to counteract the inflammation. The agents of this class are not very extensively used in the treatment of dentine, not because they are not ultimately efficient, but because their action is less vigorous than that of some other agents. When, however, time and circumstances will permit, mild treatment, if efficient, is to be preferred.

But there are many cases in which, for want of time, something more rapid in its action is required. Of this character is the second class of therapeutic agents, namely, escharotics, or those which, by their action, destroy a portion of the tissue with which they come in contact. It may be well to notice, separately, the preparations commonly used for this purpose.

Tannin, or Tannic Acid.—This is the active principle of vegetable astringents, and is found most abundant in nutgalls. It unites with albumen, fibrin, and gelatin, forming with them insoluble tannates. Its medicinal influence is almost necessarily topical, since the promptness of its action on albuminous substances, and the insolubility of its compounds with them, prevent its admission into the general circulation. The action of tannin on dentine has been already explained. Either its aqueous or its alcoholic solution may be employed, the latter being the better and more convenient preparation. Where tannin is applied to dentine, there is formed a tannate of albumen, which, being insoluble, protects from irritation, and probably incites to healthy condition, the living parts beneath it.

Creosote, or Carbolic Acid.—Formerly, creosote was obtained by distillation of wood, and differed somewhat from that in present use, which is prepared by distillation of coal tar—this latter being the genuine carbolic acid. It dissolves freely in alcohol or ether, and sparingly in water; and its action may therefore be modified by dilution. Creosote produces its caustic effects by its affinity for albumen and gelatin, with which it forms insoluble compounds; and from its *modus operandi*, it is evident that the popular opinion that it promotes decay of the teeth, is an error.

Nitrate of Silver.—This salt is a powerful caustic, whether applied to soft parts or to bony tissue. Its action is somewhat complex. Nitric acid is liberated by the decomposition of the salt, when in contact with organic matter. Nitrate of silver has a strong affinity for albumen, uniting with it without difficulty; and the compound thus formed, is soluble in nitric acid or in a dilution of chlorid of sodium. When the nitrate is applied to the skin, the immediate result is a whitish mark, caused by a union of the salt with the albumen of the cuticle; but this soon turns black, by the reduction of the salt and the decomposition of the silver; when, for each atom of silver set free, there is liberated an equivalent of nitric acid. There is here, then, an agent that acts promptly on the gelatinous portion of the tooth, destroying its vitality to the extent of the combination which takes place, and that, by the decomposition of part of the salt, and the consequent liberation of part of the acid, also acts with energy on the calcareous portion. The compound formed by the nitrate with the organic constituents of the tooth, is insoluble except with a few substances, and therefore protects the subjacent parts; and the precipitation of the reduced oxyd on the surface, affords some additional protection. The insolubility of the compound above mentioned, prevents an absorption of the nitrate by the dentine, and renders its action necessarily superficial. When the nitrate is neutralized by a union with it of an equivalent of the constituents of the dentine, no further chemical action is possible. The compound formed by this union is soluble in a dilution of the nitrate; and if this be applied in too great a quantity, there may be a larger loss of substance than is desirable or at all necessary; for, as long as free nitrate remains in solution in the cavity, the insoluble compound is not precipitated, and the surface is therefore exposed to the continued action. It is preferable to employ the nitrate in the solid state, or, when this is not practicable, in a concentrated solution and small quantity, rather than in a copious dilution and repeated application.

From the observations already made, it is quite evident that no harm can result to the tooth from a proper application of this agent, beyond the portion of it immediately acted upon. The nitrate can not be absorbed by dentine, but it stimulates the subjacent dentine to more healthy action; though some maintain that it is not as efficient in this respect as some proper chlorid. It acts to a greater depth than tannin or creosote, but not so deep as chlorid of zinc, nor with so much pain.

Chlorid of Zinc.—This is more generally used in the treatment of sensitive dentine than any other caustic. It exerts an antiseptic and disinfectant, as well as an escharotic influence. In its operation it decomposes, the chlorine affinitizing with the animal and the calcareous elements of the dentine. It is milder in solution than in solid, and less efficient and less painful. It is soluble in water, alcohol, ether, or chloroform. The etherial and the chloroformal solutions are, in their action, least painful of all the forms in which this chlorid is applied. The union of this agent with the gelatinous constituent of the tooth is also more prompt in solution than in solid. The ether and the chloroform may lessen the pain by their anesthetic influence. In the use of the chlorid or any other active caustic, it is important to bear in mind the exalted vitality which follows its application; and the operation should be immediately performed. In the teeth of young persons, or those in which the animal constituent greatly predominates, the vitality will be more promptly aroused than in those of an opposite texture, and the change, too, will be greater. If the inflammation is confined to a thin lamina, it will be almost instantly allayed by the application of the chlorid, and the cavity may be excavated, as though there had never been any exalted sensibility; but if the operation be delayed any considerable time, the tooth will often be found in a worse condition for excavating than before the application. The remarks on absorption under the head of *nitrate of silver*, apply with equal force here: there is not the least danger from this source; indeed, there can be none, even when the chlorid is applied to the soft parts.

Terchlorid of Gold.—Of this preparation the etherial solution only has been employed. This acts with great promptness on the dentine, forming an insoluble compound with the gelatinous elements, and the chlorine of it forming also a combination with the calcareous portion. On account of the promptness with which this agent operates, neither the pain nor the disturbance of the subjacent parts caused by it, is great. This substance is very liable to decomposition. By exposure to air or light, the gold is precipitated in the metallic form. But, protected from these, it may be preserved for a long time. This agent will not be absorbed by the dentine.

Arsenious Acid.—The *modus operandi* of this agent is involved in great obscurity. In regard to its topical action, Professor Bache, says: "Arsenious acid, when it produces the death of a part, does not act, strictly speaking, as an escharotic; it destroys the vitality of the organized structure, and its decomposition is the consequence. The true escharotic acts chemically, producing a decomposition of the part to which it is applied; a state incompatible with life." Pereira says: "Though employed as a caustic, yet the nature of its chemical influence on the animal tissue, is unknown; hence it is termed by some a dynamic caustic." Its escharotic power certainly bears no proportion to its vitality; but it is probable that it forms definite compounds with some of the constituents of living tissue; and if so, these compounds appear to be readily and rapidly decomposed, so that the acid becomes again free to attack, with similar results, the subjacent parts. The topical application of arsenic is liable to be followed by constitutional effects.

All dentists are aware of the fact that a tooth-pulp may be destroyed by arsenic, through a wall of considerable thickness. To accomplish this, the agent must in some way penetrate the substance of the dentine; and the vitality of the dentine is destroyed so far as it is thus penetrated; indeed, the vitality of the whole crown of the tooth, both dentine and pulp, is often destroyed by the use of this remedy, applied even to a small cavity. Exalted sensibility of dentine is subdued by this agent, more through its vital, than through its chemical energy. It is very soluble in creosotes and all similar oils, and, to a considerable extent, in alcohol and water. It is absorbed much more rapidly in solution than in solid; and the more vascular the dentine, the more rapid and extensive will be the absorption; and on this account there is great risk in applying it to the teeth of young persons, or to any teeth that are highly vascular; indeed, it will, in some cases, destroy the vitality of very dense teeth. The manner in which it passes into the dentine, is not very definitely understood. It is very certain, however, that in more highly organized parts, it is carried through by the circulation, and also may be taken up by imbibition. In either of these ways it may pass into the dentine, and so far as concerns the results, it matters not in which way. It is enough to know that there are well defined cases of its specific effect on the constitution, after having been applied to toothbone—demonstrating that it must have been taken up by the circulation; and also cases of its manifest effect on the periosteum in a short time after having been applied to the cavity of a tooth, the pulp of which is dead—thus proving that it must have been absorbed by imbibition.

If arsenic is ever employed in the treatment of sensitive dentine, it should be suffered to remain in the cavity but a short time—from one to three hours —and then the part with which it was in contact, should be very thoroughly excavated; and in deciding in what cases it is proper to use it, there is need of careful discrimination as to the tooth's structure and density; for injurious results have sometimes followed its application, notwithstanding the utmost care: if it has once been absorbed by the dentine, antidotes will avail nothing. On the whole, therefore, it is probably better to refrain from its use altogether in the treatment of sensitive dentine.

Alkaline caustics have been, to some extent, used for the treatment of this affection. A preparation made after the following formula, is said to relieve some cases very promptly: take Canada balsam and slacked lime, and, having made them into a paste, fill the cavity partially full with it, and permit it to remain until the object is accomplished.

The sensitiveness of dentine may be obtunded by thorough friction on the affected part with a smooth burnisher. This method, however, is applicable only to those cases in which there is room to use the instrument. On the surfaces of the teeth, where there may be sensitiveness, it is very applicable and very efficient. Simple pressure, without friction, it is suggested, will accomplish the same object; though pressure and friction combined, are doubtless more efficient.

CHAPTER IX.

EXPOSED PULPS.

USUALLY, when the pulps of the teeth are exposed, it is in consequence of decay, but sometimes of a gradual wearing-down of the organs in mastication. When the pulp of a tooth is found exposed, the course of remedy to be pursued, will be directed by the following considerations:—

1st. The constitution and the vital energy of the system.

2d. The condition of the mouth and teeth.

3d. The condition of the pulp.

4th. The size of the orifice at which it is exposed.

5th. Whether the exposure is of recent, or of remote origin.

6th. If in a tooth of more than one fang.

7th. The position of the tooth in the mouth, and that of the decayed cavity in the tooth.

The propriety of attempting to preserve the vitality of the pulp after exposure, has been questioned. Some take the position that after the development and formation of the tooth, the pulp is no longer of any use, and may, without damage, be dispensed with; while others maintain that, when the pulp of a tooth is destroyed, the tooth is no longer of any value. The truth is, perhaps, a medium between these extremes. The pulp of the tooth is valuable in the economy, or nature would dispense with it. Analogy teaches that it would not be retained longer than it could subserve some beneficial purpose. But it is also true, that a tooth may be valuable for a long time after the destruction of its pulp, notwithstanding it is in a less perfect condition; though it is always desirable perfectly to preserve the life of the tooth; for the crown depends on the pulp for its vitality, and living dentine opposes more resistance to decay than dead; besides, a dead tooth never presents the bright, lifelike appearance of a living one. The parts about a dead tooth, too, are far more liable to disease than those about a living one. These are only a few of the prominent arguments for retaining the nerves of the teeth.

It has been maintained that the structure of the tooth-pulp is of such peculiar character, and so susceptible of diseased action, that after it has become affected, though but slightly, it can not be restored to a healthy condition. We see no ground, however, for such an assumption, except it be in the imperfect treatment which this organ so frequently receives; for the fact of its delicate structure does not necessarily imply an impossibility of restoring it from disease. The pulp of the tooth is endowed with such functions as ordinarily render living tissue susceptible of treatment for abnormal conditions; as circulation, nutrition, absorption, and a distribution of nerves. The success attending the methods of treating exposed pulp, practised by the dental profession during the last few years, is a source of more encouragement than a thousand theories.

Treatment of Exposed Pulps.—In cases where the conditions are favorable,—the constitution good, the pulp but recently exposed at a small orifice, and in a healthy condition, treatment may be instituted with considerable certainty of success. If there is no inflammation or irritation, therapeutic treatment is not indicated; but the decay should be removed and the cavity formed without wounding the pulp, if possible; though a slight wound is of no serious consequence; for immediately after the hemorrhage ceases, the operation may proceed as though the pulp were intact. There have been suggested various methods for protecting the pulp in cases of this kind: formerly, the capping of nerves was very extensively practised; by which a shield was thrown over the pulp, so as to prevent the filling from coming in contact with it. Various materials have been suggested for caps; but gold and lead have been chiefly used for the purpose, especially when the object was to form an arch over the point of exposure. These caps are cut out of thin gold plate, or thick sheet lead, of the proper shape and size, and stamped with a convex punch, thus receiving such a concavity as fits them for covering the exposed pulp without touching it. A little groove, of depth sufficient to hold the cap and prevent it from being displaced by the introduction of the filling, may be made in the dentine all round the orifice of exposure. The cap is then to be adjusted to its position in the cavity, having been previously touched round its edge with adhesive wax, and the filling to be introduced in the usual manner, carefully, so as not to displace the cap; and if this is of lead, great caution is to be observed in condensing the filling above it, since it will be easily compressed.

The therapeutic influence of lead on exposed nerves is supposed by some to be definite and decided; but, though lead is a less perfect conductor of heat, and in this respect is better than gold, and though, in the capacity of a pulp-cap, its indestructibility is probably quite sufficient, yet, if no change takes place in it, it is not very apparent how it exercises any therapeutic action on the pulp. Experience, however, proves that the success is quite as good in the use of lead caps as in that of gold; and the former are much more easily formed.

There is an other method of shielding an exposed pulp, which is, to form an arch over it by the filling. This operation is performed by beginning the filling at that side of the cavity most easily approached, building on the gold from the bottom to the orifice, up almost to the point at which the pulp is exposed, and then attaching the pieces of gold to the preceding part, without permitting them to come in contact with the pulp, interposing a fine burnished point between this and each piece as it is introduced, and thus giving a smooth surface to that portion of the filling next the nerve. When, by this process, the filling has been extended beyond the point of exposure, it may be dropped down on the body of the dentine, and finished in the usual manner. This method of forming a protection over a tooth-pulp, possesses no advantage over the ordinary cap; and being much more difficult, it is impracticable in any but skillful hands.

This practice with exposed nerves, however, has, within the last few years, been almost wholly abandoned, and for these two reasons: because it so frequently failed to accomplish the object, and because a better method of treatment has been discovered. It was found that, under that practice, many cases which at first promised well, failed to preserve the life of the pulp; though the fatal results were not always immediate, a year or two, and, in some instances, a much longer period, intervening between the operation and the death of the tooth. In favorable cases, the pulp, even after exposure, will, if protected from the influence of foreign substances, throw out a bony deposit, and even close up an orifice of exposure, thus forming for itself a natural shield. It is submitted that the capping operation is not the best protection for facilitating this process. It is probable that, in some cases, the space between the cap and the pulp, though it were large, would be filled with coagulable lymph; yet, even if it were thus filled, this lymph might not be formed into bony tissue; and if it were not, it could not fail ultimately to prove injurious to the pulp. But if the space should not be filled with lymph, the difficulty would be equally as great, since the pulp would protrude through into the vacuum beneath the cap, and necessarily become diseased, since it would be irritated by its contact with, and its pressure against, the sharp edges of dentine at the orifice of the cavity; and it may remain thus diseased for a long time, or die at once. Thus it is, no doubt, that the great majority of failures occur under this kind of treatment. In order to obviate this difficulty, it has been suggested that the space under the cap be filled with some appropriate substance, as a thick solution of gutta percha and chloroform, or a small pledget of cotton saturated with collodion.

The frequent failures which occur in capping nerves, have incited the profession to seek some other method of treatment. A vacuum above the nerve being objectionable, some suitable material is employed as a shield for this, being placed on the orifice of exposure, in contact with the nerve; and the filling is then introduced without any pressure upon the point of exposure. There are several substances that have been thus employed, the chief of which are asbestos, oiled silk, collodion, gutta percha, and horn. The material for this purpose should be a nonconductor of heat, should not be subject to decomposition when in contact with the pulp, and should present a smooth surface and be easily adapted. In shielding a nerve in this manner, it is important that pressure be not made upon it; and there is not much liability to this, where the orifice of exposure is small; but, where it is large, much care is required in the introduction and consolidation of the plug. The opinion has been entertained by some, that the pulp of a tooth will not tolerate any foreign substance in contact with it; but facts refute such an opinion. By this kind of protection for a nerve, secondary dentine is more likely to be developed.

A very perfect covering for an exposed pulp may be made by dropping on it a little collodion or solution of gutta percha, and then, after the evaporation of the ether or chloroform, filling over it. This method has the advantage of completely filling and occupying the space, and exactly conforming the filling to the part. When the exposure is at a large orifice, if the pulp is healthy, and the constitution of the patient good, the same general course of treatment may be adopted, except that more care and skill will be necessary in the performance of an operation. Indeed, it is difficult to make a good operation in cases of this kind, using for the covering only a soft or a very flexible material.

A method of operating, that is probably more efficient than any other, is, to prepare the cavity as already directed, place on the pulp two or three drops of collodion or solution of gutta percha, letting it partially stiffen, and then over this fit a gold cap as exactly as possible, so that it shall rest on the solid dentine far enough from the orifice of exposure to preclude it from injurious influence on the pulp. On this, the filling is introduced as usual, care being had not to displace the cap, which, in all such cases, should have a seat made for it, adapted at the time of the preparation of the cavity.

When the pulp of a tooth becomes, by exposure, inflamed or diseased, some more special treatment is indicated, and usually it is therapeutic. In every such case, the treatment will contemplate two objects: the preservation of the pulp, when the circumstances will warrant; and when they will not, then its destruction. The former of course is always to be preferred, where practicable. Some of our best operators very strongly denounce that wholesale destruction of the pulps of teeth, practised by many; while some dentists never attempt to restore them to health at all, however slightly diseased. This, as elsewhere intimated, is erroneous practice; for there is no obvious reason why the pulp of a tooth may not be restored from disease to health as readily as other parts, endowed, as it is, with circulation, nutrition, absorption, and the distribution of nerves. The particular kind of treatment required in any given case, however, will be controlled by various circumstances; such as the nature and extent of the disease; whether it is of chronic or acute type; and when the irritation, or inflammation, is but slight, and is kept up solely by the contact of irritating substances, restoration of the pulp may be effected by a removal of these irritating causes, and a protection of the pulp against their further influence: in such case, nature, unaided, effects the restoration. In default of a vigorous constitution, the pulp, though but slightly affected, will require topical therapeutic treatment; and meanwhile general treatment may be employed to give increased tone to the system. In the local treatment, neutralizing agents should be applied first, and afterwards such as will counteract and reduce inflammation, especially if this is in an active state. But if the pulp is in a morbid condition, with retarded circulation, and a tendency to enlargement, very active and stimulating applications will be indicated, and in some cases escharotics, such as nitrate of silver and chlorid of zinc, the latter especially where there is a tendency to prurient enlargement of the pulp. Four therapeutic principles, namely, astringents, tonics, stimulants, and escharotics, are mainly to be relied upon in the topical treatment of exposed pulp; but a detailed account of the nature, influence and effects of all the individual agents embodying these principles, and of the respective methods of applying them, belongs rather to dental therapeutics.

The length of time requisite for the treatment of exposed pulp, will vary with different cases. In the case of a recent acute inflammation, the process of restoration may be completed in two or three days; while, in other cases, where the difficulty is of long standing and of a more complex character, it will require from a week to two months. Leeching and counterirritation of the gums are sometimes resorted to in this treatment; but it is rare that any definite beneficial result ensues. Depletion of the pulp itself may often be practised with decided success: and it may be accomplished either by puncturing the pulp with a fine-pointed instrument, or by excising a small portion of it at the orifice of exposure with a very sharp one, in either case avoiding any laceration of the pulp. By this means the distended vessels are relieved; and in many cases, where the difficulty is but slight, immediately after such relief by puncturing, so soon as the hemorrhage has ceased, the tooth may be filled. But if the depletion is by excision, time must be allowed—ordinarily from three to ten days.

The formation of secondary dentine, by which the orifice of exposure is closed up, has already been referred to; and it has been suggested that treatment to facilitate this process may be instituted. With a view to this, temporary fillings are sometimes introduced; and irritation of the pulp by frequent slight friction, has been adopted; but the success attending this treatment is not very manifest. If a shield of secondary dentine is desirable before permanent filling, the best method of securing it, is, after seeing that the general recuperative power is in the best condition, to place in the cavity a temporary filling, of such material and in such manner as shall be least offensive to the pulp, and then leave nature to accomplish the work. In many cases, especially in young persons, this process would be facilitated by an administration of bone phosphate. The pulps of the teeth of the young are more difficult to treat successfully than those of the more advanced in life.

Destruction of the Pulp.—There are cases in which an attempt to restore the pulp, even when recently and but slightly diseased, would prove unavailing:

so feeble is the vitality that it is destroyed at almost the first touch. Two cases in *apparently* the same condition pathologically, but in different constitutions, will, under the same treatment, exhibit very different results. A pulp that is highly diseased, is but seldom, if ever, under any circumstances, susceptible of restoration; and in such case, of course, destruction is indicated. This was formerly supposed to be an impracticable operation, for two reasons: first, because it was very difficult and painful; and second, because of the consequences likely to ensue. Then, the operation was attempted only on teeth of one fang, and those of cylindrical form; but now, it is performed successfully on all classes of teeth. When destruction of the pulp is decided upon, such means should be employed as will effect the object promptly and thoroughly. Every thing should be entirely removed from the pulp-chamber and the canal of the fang; for any remaining portion is liable to inflammation and suppuration; and alveolar abscess, too, frequently ensues.

There are two methods of destroying the pulp: the one, by an operation; the other, by a therapeutic application. The choice of these methods will be governed by circumstances; such as the temperament of the patient, the condition of the tooth and parts about it, the class of the tooth to be operated upon. For patients of a nervous, irritable temperament, to

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After the pulp has been thus exposed, the instrument should be selected for its removal. There are different forms of instruments for this purpose. Some operators employ the untempered, four-sided, barbed broach, thrusting it up into the canal as far as possible, then twirling it two or three times around, and thus wrapping the nerve round the instrument; when both are drawn away together. This method always occasions considerable pain. Others employ simply the three- or four-sided broach, thrusting it through the pulp all the way up the canal, and thus lacerating it and breaking up its structure, so that it may afterward be removed without much pain. An other very awkward and bungling method is, to force up into the canal a piece of wood adapted to the size of the space, and thus drive the pulp before it all the way. Of all the methods of destroying the pulp, this is the most objectionable, and should never be employed. An other method, and the one which seems preferable to all others, is as follows: take a very fine untempered steel wire, round and smooth, not larger than 34 to 36 of Stub's gaugeplate; flatten the extreme point, and turn it to an angle of from thirty to forty degrees; place the edge of this against one wall of the canal at the point of exposure of the pulp; press it steadily up the canal, with its edge bearing against the wall, as far as it will go, and then twirl it suddenly round: thus an excision is effected near the point of the fang, when the pulp with the instrument may be drawn away together; or, if not thus drawn, it may be caught with some fine point, and removed without pain. This manner of introducing the instrument, too, causes less pain than either of the others; for there are no sharp edges or points presented in passing the instrument up the canal, to cut or lacerate the pulp. In the removal of the pulp from the teeth of young persons, care should be taken lest the instrument pass entirely through the foramen, at the apex of the fang; but with adults, there is little or no danger of such an accident.

The directions given here would be quite sufficient, if closely followed, for the removal of the pulps of the six anterior superior teeth. In order to the removal of the pulp from the bicuspids, the entrance can ordinarily be effected through the decayed cavity. Usually, there is some lateral compression of the fangs of these teeth; and the canal through the fang partakes of the formation, so that it represents a mere fissure expanded a little on each side of the center. It is often difficult, and requires very delicate manipulation, to remove all the pulp from these fissures: a very fine instrument may be pressed down each side, and yet a portion of the pulp remain in the center. This difficulty is most fully presented in those cases in which there has been an apparent, though abortive, effort of nature to produce two fangs.

The removal of the pulp of the molar teeth is a more extensive and complicated operation. The pulp to be operated upon should be fully exposed, the orifice of exposure being made as nearly as possible of the size of the pulp-chamber; and the instrument to be used, should be such as last described, except that it should be much larger, and is to be introduced, in the same manner, to the bottom of the pulp-chamber, and rotated suddenly, so as to cut off the ramifications of the pulp into the fangs, thus at one sweep dislodging the entire body of it without laceration. The practice of plunging a large barbed or cutting instrument into the pulp of a molar tooth, is barbarous in the extreme. The branches of the pulp in the fangs should be removed in the manner already directed for the removal of the pulps from teeth of single fangs. The palatal fang is very easily operated upon; but, as to the buccal fang, there is frequently encountered the same difficulty referred to in speaking of the bicuspids. Commonly, when a pulp is removed in this manner, the wound of excision heals by first intention, and there is formed a permanent cicatrice.

Actual Cautery.—Formerly, for destroying tooth-pulp, the actual cautery was employed to a considerable extent, and was at one time a favorite method with French dentists. This consists in heating a wire of proper size to a white heat, and thrusting it up the canal of the fang to the apex, the object being to destroy the pulp the instant the wire comes in contact with it. The operation requires much skill, and is attended with many difficulties. It is fraught with terror to the patient; if the temperature of the wire is not at the white heat at the time of its insertion, the pain of the operation is most intense; it is liable to leave the parts in such a condition as often to induce inflammation and suppuration, which may involve the investing membrane and the surrounding parts. Besides, by this method, the object is, at best, no more successfully attained than by others.

Potential Cautery.—This term is applied to those therapeutic agents which destroy vital tissue by establishing a condition incompatible with vitality. Many preparations have been employed as topical applications to destroy the pulps of teeth, but only two or three to any considerable extent. A consideration of the nature and specific action of these agents may not here be out of place; and, first, of

Arsenious Acid.—This has been more used, topically, for the destruction of tooth-pulp, than all the other applications. The first account we have of its use for this purpose, dates back to 1836, when it was applied by Dr. Spooner, though others claim to have employed it at about the same time. The specific action of arsenious acid on vital tissue is not well understood. It is supposed by some that it forms a compound with some element of the tissue, and in this way destroys the vitality.

Any such combination, however, has hitherto escaped detection; and it is certain that if a compound is formed, it is not fixed or permanent in its character, since the arsenic will be carried to different parts of the system, and its specific influence manifested wherever it goes; which could not be the case if it formed a fixed compound. The more probable theory is, that it destroys vitality by its influence on nerve tissue. Animal tissue takes it up by imbibition; and it is also absorbed by the circulation, and conveyed by it, as already suggested, throughout the system. Frequently, however, it is applied to living tissue under conditions that prevent such absorption. It is often employed in the treatment of carcinoma. In the application of arsenious acid to the pulps of teeth, for their destruction, several circumstances are to be considered; such as the age of the patient, the constitutional tendency, the vascularity of the dentine. Where the vascularity is great, the utmost caution is required. The indiscriminate use of this agent in the teeth of the young, is attended with great risk. Some constitutions are peculiarly susceptible of its influence, experiencing its effects even in remote parts of the system, after its application only to the pulp of a tooth. It is absorbed more readily in solution than in solid. It is very soluble in creosotes and all the oils of that nature, and somewhat soluble in alcohol and water. In many cases, when it is applied to the pulp of a tooth, more or less disturbance of the periosteum is exhibited a short time after—in some instances in a few hours, and in others after several days; thus giving evidence that it has, by some means, come in contact with the periosteum. Its influence on this will often be manifested under percussion, in advance of any other symptoms.

Application.—There are two or three methods of applying arsenious acid for the destruction of the pulps of teeth. The ordinary arsenic of commerce is used. It was formerly employed very extensively in connection with sulphate of morphia, mixed in equal parts, and applied to the pulp with a small pledget of cotton, moistened with creosote or any other essential oil, the former being most frequently used. Alcohol, ether, or water may be employed in stead of creosote, and in some respects and in some cases would be preferable. The pledget of cotton, thus prepared, is introduced into the decayed cavity, with the preparation in contact with the exposed pulp. An other pledget of cotton, saturated with a thick solution of gum sandarac and alcohol, or gutta percha and chloroform, is placed over this in the cavity, to prevent the escape of the preparation, or the entrance of moisture or foreign substances: any preparation may be used, that will accomplish these objects. In the application of the pledget, care must be exercised lest too much pressure be made on the pulp, and pain be thus produced. In order to prevent this pressure, an other method has been adopted, which consists in forming a cap of lead, placing in it the arsenic, in the dry state or with some suitable solvent, and then fitting it over the exposed pulp, and retaining it there with a pledget of cotton, as above, or with Hill's Stopping, gutta percha, or adhesive wax. Thus the preparation comes gently into contact with the pulp, and prevents any pressure on it. The morphine is used for the purpose of diminishing the pain which frequently results from the application of arsenic; but its influence for such a purpose is predicated more on theory than on practice; for facts prove that, applied to living tissue, it produces pain rather than allays it. Therefore the more observing and better class of practitioners have discarded it.

Other substances have been mixed with arsenic, for the purpose of mitigating or altogther relieving the deleterious consequences so liable to follow its administration; as, for instance, pulverized charcoal, which combined with it in equal parts by weight, makes a favorite preparation with good practitioners, by some of whom it is claimed that the charcoal counteracts the specific effect of the arsenic on parts other than those for which it is directly designed.

But this theory, in the light of any elucidation yet given, is very vague. The claim can not be, that charcoal is an antidote to arsenic, since facts refute it; for if it were such antidote, the arsenic of the preparation, when applied to the pulp of a tooth, would fail of its effect, because the charcoal, being also in contact with the pulp, would there, if ever, counteract the poison. But this it does not do; for the pulp is destroyed about as readily by this preparation as by arsenic alone. And if, when the arsenic and charcoal are thus together, no counteracting influence of the latter is manifest, much less will there be any when the arsenic, escaped from the charcoal, runs riot through the organic tissues, whither the latter can not follow. The only probable advantage, then, of this preparation, is, that the arsenic is not taken up from it by the tissues so rapidly, as when that is applied alone or with any thing that is soluble with it; for, when thus applied, the whole is very soon dissolved, and taken up by the pulp and dentine. But, when combined with charcoal or the like, little more of the arsenic is absorbed than that which comes in contact with the pulp. Hence the conclusion, that the influence of the charcoal is mechanical, and not therapeutic.

This preparation is better applied perfectly dry, beneath a lead cap, which should completely close the cavity. Any other material that would mix as readily with the arsenic, without being soluble, and that would not induce irritation when in contact with the pulp, would be quite as good for this purpose as charcoal. Irritating gasses generated in a tightly closed cavity, may be absorbed by charcoal.

Cobalt, in which the active principle is arsenic, has been extensively used for destroying nerves; but it is in no respect superior, and in some respects it is probably inferior, to the preparation of charcoal and arsenic: it is applied in the same manner.

The length of time the preparation should remain in the tooth, will be determined from the condition of the pulp when it is applied, the age of the patient, the vascularity of the dentine, the susceptibility of the patient to the influence of arsenic, and the like circumstances. It will usually be from three to twentyfour hours. In some cases, a very small particle will thoroughly accomplish the work; while in others, a much larger quantity may remain in contact with the pulp even for a much longer time, without producing more than a superficial result. And cases occasionally occur, in which it seems almost impossible to destroy the vitality of a pulp with arsenic. A case is on record, in which the pulp was first fairly exposed in a superior bicuspid tooth, the health and constitution being good, and the temperament sanguine-lymphatic; and arsenic with morphine was applied to it, directly, five times within ten days, without producing any apparent effect; then an application of creosote and tannin was made three or four times, during as many days; afterward the tooth was temporarily filled with gutta percha; and finally, in ten or twelve days, this filling being removed, the pulp appeared in a state of perfect preservation and health, with all the indications of undiminished vitality. Over the exposed point there was placed a nonconductor, and upon it a filling of gold; and one year after, the tooth presented the appearance of perfect life and health, having given the patient no annoyance during the whole period. Several similar cases might be cited, if it were necessary.

Hence it is quite obvious that there is a great diversity of susceptibility to the influence of arsenic, and that the study of these idiosyncrasies is both interesting and valuable. The recurrence of injurious consequences from the use of arsenic, has induced many operators to abandon it altogether. But these injurious results perhaps occur always either through maladministration, or from a peculiar susceptibility to the influence of the drug; and a superior skill and a more accurate diagnosis would avoid them entirely. After the desired result with arsenic, it has been thought that antidotes might be made available. The hydrated sesquioxyd of iron is one of the best antidotes to arsenic, and has been used in the teeth to counteract its injurious effects; but it is of no avail here; the arsenic has the start of it, and, indeed, would outstrip it, with an equal start.

From the foregoing in regard to arsenic as an application for destroying the nerves of teeth, the following conclusions are justly deducible: it is, in general, very efficient; it is a heroic agent; it should, in all cases, be used with great caution; in some cases it is entirely inadmissible; a free administration of it is liable to be succeeded by bad consequences; and skill, rather than counteracting agents, is to be relied upon in its application.

Filling Pulp Cavities and Canals.—After the pulp of a tooth has been destroyed, whether by an operation or by therapeutic treatment, the part at the point of its detachment should, in almost all cases, before the filling is introduced, be rendered sound; if possible, a permanent cicatrice should have formed. In cases, however, of good constitution and strong recuperative power, where a nerve has been removed by an operation, the fang may be filled as soon as the hemorrhage has ceased; but such cases rarely occur. Generally, the part will require treatment; and the character and duration of this will be determined by the circumstances—as, the vital energy of the system, and the method employed for the pulp's destruction. When this has been effected by an operation, the part of detachment is restored to soundness much more readily than when by an application of arsenious acid, and less topical treatment will ordinarily be required; indeed, in many such cases there will be nothing else necessary, than to keep the canal well cleansed, so as to obviate any irritation that otherwise might be induced by the offensive gasses or fluids of decomposition. But it is generally best to employ some deodorizing agent, such as chlorid of sodium, in these cases. When the pulp has been destroyed by arsenious acid, more energetic treatment is usually demanded; for then there is always a greater or less disposition to slough or discharge through the tooth; which must of course be entirely abated, before the operation of filling is at all admissible. In the treatment of this condition, the canal should be kept perfectly clean by frequent syringing; floss silk, moistened with some suitable liquid, such as a solution of nitrate of silver, or creosote and tannin, should be introduced up to the inmost part of the cavity, and should be changed every twentyfour hours, the cavity being thoroughly washed each time. It will be necessary, in many cases, to continue this treatment for several days. In order to determine whether the condition is such as to admit of the filling, the floss silk should be removed after a sufficient time is supposed to have elapsed, the cavity thoroughly cleansed and dried, and a portion of dry floss or cotton introduced loosely into the canal. Then close up the decayed cavity with adhesive wax, gutta percha, or some other substance that will effectually exclude the moisture; let it remain thus from twelve to twentyfour hours; then open the cavity, and withdraw the silk or cotton, and if this is found free from moisture and odor, the tooth is ready to be filled.

The treatment just described will be sufficient for all cases in which the pulp has been destroyed by the operator. But teeth whose pulps are already dead, would seem to be less difficult of treatment and filling; yet they are not so;—indeed, the therapeutic treatment of these is usually more protracted, and their diseased condition less easily controlled; and this because of the fact that the decaying pulp, remaining in the canal, becomes very offensive to the living parts adjacent, in which it induces a chronic diseased condition, frequently involving the dentine along the walls of the canal in decomposition.

A classification of these teeth, based on their conditions, might be somewhat auxiliary to a further examination of this subject; and the following will probably embrace them all:—

1st. Those whose pulps are dead, but their remaining parts alive and healthy.

2d. Those predisposed to disease.

3d. Those already diseased, either discharging acrid matter through the fang, or exhibiting inflammation of the periosteum.

4th. Those having alveolar abscess.

Sound or slightly decayed teeth are sometimes found with dead pulps. This condition may be produced in various ways: by blows, or by any force that will partially loosen the tooth; by undue pressure in filling; by excessive sensitiveness of the dentine, even where the decay is not extensive; and, sometimes, by a filling of the tooth when it is in an unfit state for the operation. Ordinarily, in cases in which the pulp is dead before its exposure, and there is no abscess from the fang or periosteum, the nerve-chamber may be opened, and the remains of the pulp removed. The canal should then be cleansed out, and floss silk saturated with chlorid of sodium, introduced and permitted to remain from one to six hours; when it should be withdrawn, the pulp-cavity and the canal again thoroughly cleansed, and, there being no discharge of pus through the fang, it may then be filled. The fact that the dead pulp is inclosed in its chamber without producing irritation, is evidence that there is no secretion of pus. Occasionally, where the pulp has died from exposure, the living part immediately adjacent will present a healthy condition, and there will be no discharge; such cases should be treated in the manner just described. In operating on teeth already dead, more delicate manipulation is requisite to prevent irritation, than on those in which the pulp is destroyed by the operator. In very many cases of dead teeth, where there is not a state of actual disease, there is a strong predisposition to it; and in these cases, the preparation of a cavity, or the introducing and condensing of a filling, will produce inflammation of the periosteum. When such a condition is recognized, several sittings may be required to complete the operation. But it is not always easy to recognize; yet, whenever it is suspected, it is well to press the investigation, which may be guided by the following rules: ascertain whether the tooth experiences a different sensation or any pain, under percussion in any direction; whether periostitis has ever existed in that or in a contiguous tooth; whether the parts adjacent to the tooth are in a healthy state; whether there is a general inflammatory diathesis, or an enfeebled condition. These are the prominent points in an examination of this kind.

Where this predisposition exists, it may be counteracted by general or local treatment, according as it depends on general or local causes; but in every case, this treatment should be very careful, and it will, in some instances, have to be protracted. In these cases, where there is a discharge through the fang of the tooth, such treatment should be adopted, as will most speedily and effectually suppress it; and if it proceeds from a remaining portion of the nerve near the point of the fang, this should be removed, and such application made as will prevent a recurrence of the discharge, and assist the part to recover its health. The discharging surface may be broken up by cutting it away with an instrument, or be destroyed with an escharotic—either nitrate of silver, creosote, or chlorid of zinc, in the use of which, several applications will, in many cases, be necessary. From their action, the secreting surface is destroyed, healthy granulations spring up, and a normal condition is established.

The discharge should be wholly suppressed before the tooth is filled; otherwise, alveolar abscess would be speedily formed. In cases where there is periostitis, it must be subdued before the tooth will tolerate the operation of filling. To attain this end, the treatment to be adopted will be dictated by the nature of the causes which operate to induce the disease. General treatment will be indicated only when there is a constitutional condition favorable to the local affection; but where there is no such general predisposition, the treatment should be wholly local, and may consist of the following or similar appliances: depletion, either by leeching, cupping, or scarifying the gums; or counterirritation, either by scarifying, or by the application of highly stimulating lotions. Counterirritation may be produced, also, by making a deep incision in the gum opposite the tooth affected, and introducing a little flock of floss or cotton, saturated with creosote, which is to be kept in place till the inflammation of the periosteum is allayed; which will be effected in from one to five days. The silk or cotton should be changed every day, till the restoration of the tooth to health is affected, when it is to be removed, and the wound permitted to heal. Mild stimulating applications to the gums in the immediate vicinity, so as to increase the circulation, will, in some cases, be all that is required. A vapor bath, or warm water applied to the part, is often beneficial; and, in some cases, a continued application of cold, by means of ice-water, will subdue inflammation of the periosteum. Indeed, any antiphlogistic treatment that can be adopted advantageously, may be employed in periostitis.

The periostitis of teeth whose nerves are dead, commonly has its origin at the point of the fang, from irritation induced in the outstart by the dead and decomposing pulp and other matter at that point. In many instances, the inflammation is not confined to the fang of the tooth on which it began; but it will extend to the alveolus, the gums, and the periosteum of the neighboring teeth. Whenever the existence of this disease is suspected, and yet not very apparent, as is often the case, the examination should be very thorough. In some instances, a striking of the tooth at one particular point and at a certain angle, will produce pain; whereas, percussion on any other part of the tooth, or at any other angle, will cause none at all. By an exercise of care and discrimination, the exact point of disease, if confined to a small space, may be ascertained. For instance, if striking on the labial surface of a central incisor near the point, produces pain in the socket, while striking on any other point would not, the place of the inflammation is the anterior portion of the fang, at or near its point. By such means, the skilful and discerning will be enabled to form a tolerably accurate opinion as to the extent and location of periostitis in all cases; and this is an important consideration; for, if inflammation is found confined to a small portion of a fang, the treatment, if local, should be as near that point as possible.

Inflammation of the periosteum may sometimes be induced by the presence of foreign substances forced down between the free margin of the gum and the neck of the tooth, which have remained there till they have become vitiated, so as injuriously to affect the gums and periosteum. A deposit of salivary calculus sometimes produces inflammation of the gums and periosteum. Teeth otherwise healthy are, in some instances, thus affected; though those which have lost their internal vitality, are much more liable to such disease.

Preparing the Teeth for Filling.—After the tooth has been brought to a healthy condition, the decayed cavity is first to be excavated and made of proper form, the pulp-chamber to be shaped, and then the canals and the fangs to be prepared for filling. For the preparation of decayed cavities here, the directions given on that subject hitherto, will be quite sufficient. In the formation of the pulp-chamber, the abrupt projecting portions of dentine should be cut down; and if there is any decomposition of this, it should be removed. The pulp-chamber may be, when it is excavated, of a general retaining form, or there may be retaining points made within it at proper situations. In the preparation of the canals in the fangs, some operators do nothing more than cleanse them out thoroughly. An other method is, to pass fine bur-drills into them as far as practicable, thus making the opening of the same size all the way; or to scrape out the canal with a fine No.-10 excavator. Very fine, delicate instruments are required for cleansing out and forming the canals; and they should be quite elastic and of low temper. Instruments for this purpose, are sometimes made of gold wire, to obviate the liability to break off in the tooth. But the best method of forming these canals, is with a three- or four-sided broach, tapering to a sharp point, and its inclination corresponding, as far as possible, with that of the fang. This instrument is employed to enlarge the canal, and give it a regular shape; and a variety should be at hand, so that one of the proper size and taper can be selected. In cleansing and forming the canal, care is necessary to prevent the instrument from passing entirely through the point of the fang. Such an accident is not very liable to occur with the tapered broach; but with the miniature excavator or barbed wire, it is,—especially in the teeth of the young, where the foramina through the fangs are large; and it is peculiarly apt to happen to the incisors, the canines, and the palatine roots of the superior molars. But, after the complete development of the teeth, there is no excuse for an accident of this kind; for then there is an abrupt contraction of the canal near the point of the fang, which may always be detected by a careful introduction of the instrument.

The decayed and pulp cavities and the canal all being thus prepared, are now ready to receive the filling. For filling the fang, there are several methods; one of which is, to prepare small strips of gold, of two or four thicknesses of foil, take these on the point of an instrument, and pack them into the fang, in successive folds, till the canal is full. An other method is, to take small portions of gold, and pack them in, one on an other, till the fang is full. An other is, to take strips of from two to four thicknesses, and from one to two lines wide, and roll them on a fine broach in such a manner as to make a cone-shaped block, a little longer than the depth of the canal to be filled, and of the same taper; quite a number of these blocks will be required for any given case, of various sizes, lengths, and densities; the longest, largest, and least dense should be first used, the last requiring to be of less size and greater density. These cones may be made as dense as desirable by rolling them firmly between the thumb and fingers, after having taken them off the broach. They are taken up and introduced with the plugging pliers, and passed up as near to the point of the fang as consistent with safety. In some instances, there is danger of thrusting them through the point; and, in order to prevent this, the end of the first block introduced may be made so large that it will not pass through, even when forced up; or, what is probably better, a very small round pellet of gold may be forced up the canal, as near to the point of the fang as admissible, so as to serve to set the ends of the blocks upon, and prevent them from passing too far up. The cone-shaped blocks may be introduced and consolidated with an instrument of the same general form as the canal, but much smaller. This kind of instrument should be made of untempered steel; though some operators make them of whalebone, to prevent breaking off in the fang,—an unnecessary precaution, since no skillful operator would ever break off a low-tempered, well-polished, properly-formed instrument of this kind. After a block is placed in the cavity, this instrument is thrust in by its side, thus consolidating the gold to the side of the cavity. Thus, the blocks are successively introduced and consolidated, till the canal is filled. It is better so to arrange as to introduce the last portion of gold near the center of the canal, rather than at a side. The last blocks introduced should be stiff and dense, that they may be thrust in with considerable force.

Another method of preparing the gold for filling fangs is, to take the pure metal, and roll it down, on a good rollingmill, as thin as possible, keeping it well annealed; and of this, form the cones, and introduce them as already directed. Made in this way, they are stiffer, and fill up much more rapidly, than when made of foil. They are to be condensed in the same manner. Where the canal has been formed with a tapered broach, it may be filled with a gold wire, made of the same size and taper of the broach; and this wire may be cut off at the orifice of the canal, or left protruding more or less into the decayed cavity, and be covered up with the filling.

Some other substances have been thought quite as suitable for filling the fangs of teeth, as gold. Lead has been employed for this purpose; but the principal difficulty with this is, to get it into such a condition as to be used with facility; but, if as completely introduced, it would probably answer the purpose quite as well as gold. Tin foil is also used for this purpose, and, under favorable circumstances, with success. Some experiments, too, have been made with plaster of Paris and similar substances, for filling fangs and pulp cavities; but with what success, it is not ascertained—some claiming instances of success, and others reporting, in every instance, failure; so that there are not sufficient data to warrant the adoption of any of these substances into practice.

In cases in which there is liability to irritation, the operation of filling a fang is quite enough for one sitting; and in any case, not more than three fangs should be filled at one sitting. The filling of a large pulp-cavity will occupy one sitting, and that of the decayed cavity, an other. When a respite is thus had between the filling of the pulp cavity, and that of the decayed cavity, the former should be dressed down perfectly solid and smooth, so that no moisture may penetrate it; and then, when the latter is to be introduced, the surface of the former should be roughened by being cut up with a sharp instrument, or by being indented with small retaining pits, so as to lay hold of and fasten the last filling. From one to four days should intervene between the different divisions of the operation. The filling of the decayed cavity is to be performed according to the directions already given. When inflammation ensues on an operation of this kind, recourse is had to the treatment already described for preventing, counteracting, or reducing inflammation.

Some experiments have been made to test the effect of restoring the parts to health, forming a cicatrice at the point of the fang, cleansing this out, filling the pulp cavity and the cavity of decay, and leaving the canal unfilled; and it is maintained that this method will, in favorable cases, answer the purpose quite as well as that of filling the fang, and incur less risk. The treatment will be such as already described for the restoration of diseased fangs; all discharge through the fang must be suppressed, and all foreign substances liable to decomposition, removed from the canal, so that there may be a complete restoration before this is closed.

In case a discharge of pus is made into the canal after a tooth has been thus treated and filled; in case a decayed cavity has been filled before the complete suppression of the discharge; or in case a tooth is filled, and the pulp afterward dies: in either of these cases, it is necessary to make a vent for the escape of the pus. This is done by passing a small drill into the pulp chamber or canal, just above the filling, as close as possible. The handle of the drill should be depressed, so as to give the opening a downward inclination from within outward, and thus favor the escape of any secretion.

In the superior molars, this opening may be made through the fang. It is to be made through the masticatory surface; it may, sometimes, be in the depressions on the crown surface, even though there be no filling. In incisors, it is made through the palatine portion of the crown. It is better, however, in all cases, to make an opening of this kind through the neck of the tooth, just under the free margin of the gum, since here foreign substances are not so liable to be crowded into it, as where it is through the masticatory surface. In cases in which it is obvious at the time of filling the tooth, that such an opening will be required, it is better to make it before the filling is introduced, as follows: first, prepare the decayed and pulp cavities for filling; then drill through the neck of the tooth, into the canal, to the extreme part of the pulp chamber; and finally, introduce into this hole, its entire depth, a piece of smooth steel wire, such as will closely fit, leaving it exposed through the decayed cavity—and if it is not enough exposed when introduced, the tooth-bone may be cut away about it, till it is fully exposed; when the decayed and pulp cavities are filled in the usual manner, and condensed solidly against the wire. After the filling is finished, the wire is withdrawn, leaving a smooth, continuous opening for the escape of any secretion that may collect within. When the opening into the canal is not made till after the tooth is filled, there is liable to be a space between it and the filling, that will fill up with fetid matter, and become very offensive.

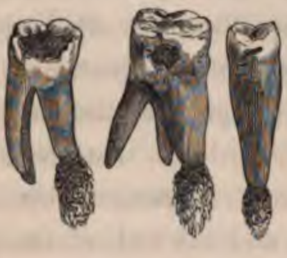
ALVEOLAR ABSCESS.

Alveolar abscess is produced, in the first place, by the formation of a secreting sac at or near the point of the fang; or, in the molar teeth, frequently in the bifurcation. The secretions of these sacs are different in character, according to the different conditions of the parts about. Sometimes, the discharge from these sacs is from the fang; sometimes from between the tooth and the alveolus; and sometimes, directly through the alveolus and gums. There are occasional cases in which the discharge will be at a very considerable distance from the point of secretion; but, in such cases, the secretion always follows some natural avenue that affords a facility for its passage—as, for instance, along a suture. There are two or three cases recorded where the issue from an abscess of the central incisor was near the posterior portion of the hard palate; and, in these, the channel of the pus lay along the suture of the palate bones. Sometimes, the opening from an abscess of the first or second molars will be opposite the bicuspids on the buccal portion of the gum. Alveolar abscess is exceedingly variable in character, according to the constitutional peculiarities and susceptibilities of the patient, the condition of the parts immediately adjacent, and, to some extent, the cause which has produced it. In a good constitution, after an abscess is formed, it will discharge healthy pus. Occasionally, yet very seldom, does nature alone effect a permanent cure. In constitutions of a cachectic diathesis, alveolar abscess is liable to constant discharge of an unhealthy pus, or purulent acrid matter; and the parts about it are usually in a diseased condition.

The cases in which alveolar abscess is most likely to occur are those of a manifest inflammatory diathesis, or those in which there is considerable local inflammation, from some local exciting cause. In the cases of constitutional predisposition, the abscess assumes a chronic character, constantly secreting and discharging pus, but does not usually cause much pain, though the tooth from which it proceeds will experience some soreness and an uneasy sensation. In the acute forms of it, however, there will be intense pain. In some cases, the sac will be found producing its specific effects without much irritation of the surrounding parts; while in others, there will be maintained in them a high state of irritation, which is liable, also, to extend to parts more remote, especially if there are any irritating agents at work. Very seldom, if ever, are the parts involved in an abscess, restored by unaided nature to perfect health.

The common cause of abscess is the presence of irritating matter in the canal at the point of the fang, which, no doubt, in many cases, extends through the foramen at that point, inducing inflammation, and resulting in abscess. Usually, the sac is found at the point of the fang; but, sometimes, it is located on the side, the point remaining comparatively free. In the molars, particularly the superior ones, the sac will frequently be found in the bifurcation, often occupying the entire space between the fangs. When it is on the point of one of the fangs, this is usually the palatine. Fig. 34 represents the position of the sacs on the roots of the different teeth.

Fig. 34.



Treatment. The treatment of alveolar abscess will be governed by the constitution of the patient and the condition of the part affected; a case of recent origin will yield much more readily than one of long standing. When a case has assumed the chronic form, and the surrounding parts have become implicated in the diseased condition, a restoration to health is often very difficult. Indeed, till within a few years, the removal of alveolar abscess was thought to be, as a general thing, wholly impracticable. But, by the treatment now employed, this affection is readily cured, unless the parts in the immediate vicinity are very much involved. In some cases, the sac on the point of the fang is very large, and absorption has taken place, to accommodate it; and, though in many such instances, the sac might be destroyed, yet the space occupied by it would not be filled up with a healthy deposition. In young persons, when an abscess is formed on the point of a fang, especially in the single-fang teeth of the superior maxillar, the discharge is frequently through the tooth, in consequence of the large size of the foramen of the point of the fang; and generally, in such cases, the local treatment may be made through the canal. Sometimes the discharge is between the fang and the wall of the alveolus. More often, however, especially in persons over twentyfive years of age, the discharge is through the alveolus and the soft parts to the surface, by the shortest course.

When an alveolar abscess is influenced by cachexy or any other constitutional derangement, general treatment must be resorted to, such as the condition indicates. The local treatment always demanded, is such as will break up and destroy the secreting sac. This is effected either by surgical or by therapeutic treatment, and frequently in chronic cases, by both together; but, in the great majority of acute cases, therapeutic treatment alone will be sufficient. In order to break up an abscess by an operation, it must be easy of access; and it is very seldom that an operation of this kind can be performed through the fang of a tooth; but, fortunately, in almost all those cases where the discharge is through the fang, therapeutic treatment alone will answer the purpose. When the point of discharge is on the gum opposite the secreting sac, a sharp-pointed bistoury should be used, and the canal of discharge sufficiently opened to admit the free use of the instrument at the seat of the disease. Then the secreting sac should be dissected from the point of the fang, and its connection with the circulation severed as completely as possible, thus cutting off its supply. After this, if the case is a favorable one, nature may be left to accomplish the work; in which case, the broken-up sac will be thrown off, healthy granulations will be developed, and the parts be restored to complete health. In other cases, however, after an operation, nature unaided will not complete the cure; but such therapeutic treatment must be resorted to, as the circumstances seem to require. In some cases, the opening through the alveolus will need to be enlarged; and this part of the operation demands great care. All particles of bone should be removed from this opening, since, if permitted to remain, they would produce irritation and tend to increase the difficulty.

When the therapeutic treatment is applied through the fang, the canal is to be cleansed of all foreign and detached matter, and opened freely through to the point; and, if the discharge is very fetid, some disinfectant should be used, as chlorid of sodium or of zinc, since a fetid condition keeps up irritation. The cleansing of the fang may be accomplished by injection of chlorid of sodium; after which, the agent to act on the disease at its seat, is to be introduced. Of this agent, there are various kinds employed, the chief of which are chlorid of zinc, nitrate of silver, and creosote, the first being applied in the solid, and the latter two in the liquid state—though the nitrate may be employed in the form of crystal. The method of using the chlorid is, to pass it in small portions up the canal, on a piece of silk, with a fine probe, entirely through the point of the fang; which process should be repeated from two to six times, in as many days. After this, during two or three days, floss silk, moistened with a mild solution of creosote and tannin in alcohol, should be applied daily; and then clean silk or cotton may be worn in the canal, changed every day, for three or four days, or till it is manifest that there is no longer any discharge, and that the parts are in a healthy condition. If nitrate of silver, in solution, or creosote is used, it should be absorbed into a piece of floss silk, and passed through the fang in the manner already described. The nitrate is more prompt of action than creosote, and will accomplish a specific object in a shorter time. Either of these solutions may, by the use of a syringe, be very effectively thrown through a fang in the following manner: fill the opening into the fang with gutta percha; drill through it a hole large enough to receive tightly the point of the syringe; and then, charging with the solution, inject it through the fang; and, in cases where there is an opening through the gum, the injection may be forced round through this. The condition of the parts will indicate how long this kind of treatment should continue. Ordinarily, when the discharge is entirely through the gum, the bistoury should be used to enlarge the opening. In many cases, therapeutic treatment alone will accomplish the object; and, when the opening to the sac is large and direct, the therapeutic agents may be introduced through it right to the seat of disease. If nitrate of silver, in solution, or creosote is used, it should be introduced to the point of affection on a pledget of cotton or floss, as heretofore directed; or if, as is preferable, chlorid of zinc or nitrate of silver in solid, it should be passed through the opening into contact with the sac. This treatment should be kept up till the indications are fulfilled.

In the treatment of abscess of the inferior maxilla much difficulty is often experienced from a want of free egress for the secretion: while, in the superior teeth, the pus may frequently escape through the tooth by gravitation, this force, in the inferior jaw, increases the difficulty. The sac being usually formed on the point of a fang, the secretion then rests at the bottom of the socket, and is frequently pent up there till it finds an outlet through the gum, somewhere between the point of the fang and the neck of the tooth. It is, in many instances, very difficult to get an opening as low down as the point of the fang, since the buccal attachment to the gum is usually quite above the point of the fang, particularly in the case of the molars and second bicuspids. Very seldom, if ever, can a secreting sac on the fang of an inferior tooth be destroyed by treatment applied through the canal of the root. Some are accustomed to make a vertical incision of the gum, as low as the point of the fang, and perforate the alveolus, and treat through this channel, as already described. Owing to the disadvantage abovementioned, much more energetic treatment is necessary to attain success with the abscess of the inferior than with that of the superior teeth.

In the great majority of cases, where one third or more of the periosteum of a root is involved in abscess, the indications certainly point to the removal of the tooth. In the lower teeth, a very serious difficulty occasionally occurs from abscess, namely, an external opening and discharge; and in all cases where this condition has already been reached, the offending tooth should be removed. But, when such a result is only anticipated, and is yet contingent, treatment may be employed to avert it; and, in order to this, a deep and free incision should be made in the gum, opposite the affected tooth, and poultices applied within; and, where there is external swelling, pressure is recommended, as follows: adjust a piece of thick sheet-lead to the part, and make the pressure on this by means of a bandage comprising it and passing round the head. It is supposed that this application counteracts the gravitation of the secretion, pressing it upwards, and thus inducing it to seek an outlet at some more desirable point. If it is a worthless tooth that is producing a difficulty of this kind, it should be removed at once.

In regard to the treatment of alveolar abscess, much yet remains to be learned. With the attainments thus far made in this direction, no aspiring dentist will rest satisfied.

CHAPTER X.

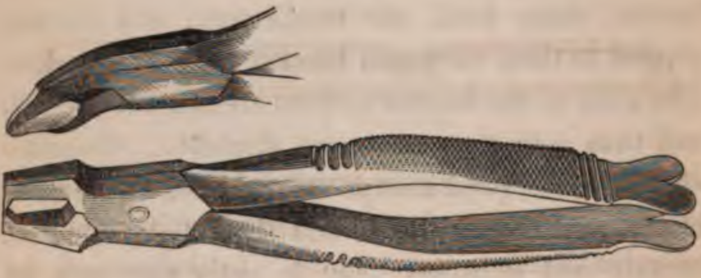
PIVOT TEETH.

Whenever the crowns of anterior teeth have become so much decayed that they can not, by filling, be rendered useful, they may, under favorable circumstances, be supplied by artificial crowns constructed on the roots. For the successful accomplishment of this work, the following conditions are important: 1. The constitution of the patient should be good. 2. The mouth should be in a healthy condition, and without diseased teeth or roots. 3. The teeth should be free from calcareous deposits and from all foreign substances liable to induce irritation or inflammation. 4. The attachment of the teeth should be perfect and healthy. 5. It is desirable that the root have a living, healthy nerve remaining. 6. The root above the neck should be sound. 7. The root should occupy a correct position in the arch. Prior constitutional treatment will often be required where there are unfavorable conditions.

The fangs of the six superior anterior teeth are better adapted for the reception of these crowns, than those of any other in the mouth. The fangs of the first bicuspids frequently terminate in two points, and are always more or less compressed, so that they will not receive a pivot large enough to sustain a crown; besides, these teeth are masticatory, and crowns pivoted to them very soon become loose and useless. The roots of the inferior incisors are also compressed, and thus subject to the same disability. Occasionally, however, pivot crowns are attached to the roots of the superior bicuspids, and the inferior incisors, cuspids, and bicuspids. But in order that such an operation shall be of any utility, the conditions must be favorable, the roots with as little lateral compression as possible, in a very sound and healthy state, and without any tendency to inflammation.

The preparation of the root for the reception of an artificial crown, is a very simple process. It will, however, be somewhat modified by the kind of crown used, and the method of attaching it. Ordinarily, the first step is, to remove the crown, or any remaining portion of it, with a fine saw or excising forceps. Of this latter instrument, there are various forms, that in most common use having narrow, transverse edges, closing squarely together, as represented in Fig. 35. With these forceps, any broken fragments of the crown can be removed with great facility. Many operators, placing their edge on the neck of the tooth, are accustomed to excise with them the principal part of the crown at a single cut. This method, however, is objectionable, since it

Fig. 35.



always gives too great a jar to the root, and is liable to loosen, and, in many instances, to fracture it, so as to unfit it for the reception of the crown. But, in every case in which an artificial crown is required, the natural crown is very much decayed; and, in this condition, is very readily removed with excising forceps, nipping it off in fragments, beginning where it is weakest and thinnest, and encroaching on it till it is all cut down—at least, as far as the forceps are available. Yet care is necessary even in this manner of using the forceps, lest the root be fractured or too much jarred.

After such excision with the forceps, the root is to be dressed down for the reception of the crown, with a round, or, better, an elliptical file. But, for this operation of removing a crown, a very fine, smooth, be enlarged to a suitable size, with the appropriate drill. If there is any remaining sensitiveness of the dentine, as is very seldom the case, the bur drill may be used for this purpose; but if not, then the common spear-pointed drill will be best. Where, however, the canal takes the form of a mere fissure, either the bur drill or the four-sided broach may be employed. The depth to which the canal should be enlarged, will be determined by the length of the fang; but it should, in all cases, be sufficient firmly to retain a pivot—which is from one to two lines; and the diameter of the hole will be modified by the size of the root. The drills should be frequently moistened with water, to prevent their clogging. The shaft of the instrument, in the operation, should be in a line with the cutting edges of the two adjoining teeth, and midway between them; and the drill itself should follow the natural canal as nearly as possible.

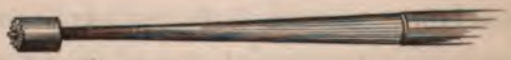
FITTING THE CROWN.

The tooth selected should be of a size, shape, and color to correspond with the natural crown which it is to represent. It should not be ground on the sides or points; indeed, ought not to be touched with the emerywheel at all. The diameter of the neck of the crown should correspond with that of the articulating surface of the root to which it is to be attached. In fitting the crown to the root, the point should be made as nearly perfect as possible; for the tooth is thus more permanent and comfortable; an open point offers a receptacle for the lodgment of food and other foreign substances, where they become vitiated, and produce unpleasant, if not injurious effects. The crown may be principally fitted to the root without pivot, by dressing it with a round or elliptical file, and frequently trying it on in about its proper position. After having been thus pretty accurately fitted, a trying pivot of soft wood should be introduced, by means of which, grinding it to its exact position, the crown may be fitted to the root.

For fitting on pivot teeth, Dr. E. Townsend invented a kind of round or convex file, with a concave counterpart, into which the file exactly fits; with the former of which the root is dressed, and with the latter, the articulating surface of the crown. This apparatus would be very good, were it not for the great difficulty of dressing porcelain teeth. By care, a very complete fit can be made with a round file alone. Some coloring material, as rose pink, for instance, may be put on the base of the crown, and then the tooth, with the pivot inserted, set in its place—when the root will be marked where the crown has touched it, and can be dressed at the point of contact. This operation is repeated till a perfect fit is attained. This method is to be recommended to those who have had but little experience in fitting pivot teeth.

An other method of making the articulation is, to dress the end of the root square, and then countersink it about half a line deep with a square-ended bur, about three fourths the diameter of the root. The base of the crown is then ground down, by the measure of the bur, perfectly round, so as exactly to fit into the depression in the root. The bur used for countersinking the root should have a center-point to fit into the hole in the fang, and thus guide the instrument. This method of fitting on crowns is objectionable, by reason of its too great exposure of the root of the tooth. Fig. 37 represents the bur used for this purpose. It is a method now very seldom employed.

Fig. 37.



Still an other method of making an articulation is, to dress up the root as first described; then take an impression of the part in plaster of Paris; and from this, get a model, to which to fit the crown. This method, however, is advisable only in cases where it is desirable to avoid annoyance to the patient by a tedious fitting process.

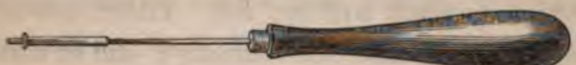
ATTACHMENT OF THE CROWN.

The means of attachment in most common use is that of wood pivots; for which, wood in the natural condition is ordinarily employed, though it is much improved by compression. The kind best adapted for pivots is the fine-grain, tough, slow-growth hickory, of straight, uniform fiber, which should be thoroughly seasoned. For its preparation, take blocks, six or eight inches long, and split them into rods, about one fourth of an inch square; then, with a knife and file, dress them down to a size one third greater than that of the intended pivots; afterward, pass them through three or four holes of the ordinary drawplate inverted, thus making them of uniform thickness throughout; and finally, turning the drawplate, pass them through it in the same manner as wire, continuing till the rods are of proper size, and all the pores of the wood are closed by compression. They should be slightly oiled before being drawn through the plate. They may be drawn so as just to fit the holes of the artificial crowns, being, of course, of different sizes. Pivots thus compressed are stiffer, stronger, and far more durable; and, there being greater density of fiber, there are less absorption of moisture, less expansion, and less liability to decay, than in wood in the natural condition.

In arranging the crown in position, care is necessary to prevent it from being struck by the teeth of the opposing jaw,—especially since it often happens, where the natural crown has been gone for some time, that the corresponding tooth of the lower jaw becomes somewhat elongated, and strikes forcibly against a properly-adjusted pivot tooth. Such an accident is anticipated either by filing off the elongated tooth, or by grinding out the palatal portion of the artificial crown sufficiently to accommodate the elongation. The former is the better method, and should always be adopted when inflammation of the dentine, exposure of the pulp, or an irascible condition of the surrounding parts, does not forbid it: though, in many instances, both methods may be advantageously employed. But, by whatever means, the antagonizing teeth should always be prevented from coming in contact with the artificial crown; and this latter should never press against the tooth, on either side of it;—indeed, it would be more desirable that there should be a small interval on each side.

When the crown is in its proper position, the hole in the root and that in the crown do not always have precisely the same direction; in which case, a pivot will be required, having a curvature according to the variation; and the extent and direction of such inflection, should be carefully observed while adjusting the crown with the trying pivot. The pivot is to be neatly and accurately fitted into the crown first, and then the length of it required for the root, ascertained with the gauge represented in Fig. 38. This gauge

Fig. 38.



consists of a wire of a size freely to enter the pivot-hole, having a little slide with a flange attached. By introducing this wire into the pivot-hole, the slide is pressed back, and the depth of the hole indicated at once. The pivot is then cut off accordingly, and dressed to the proper size and inclination, and gently pressed to its place with the thumb and fingers. Before being introduced, however, it may be wrapped with gold foil, which will serve to protect the dentine of the root from decay, and also to preserve the pivot. Two or three thicknesses of gold foil, too, may be placed between the crown and the root, so as to make a more perfect joint and exclude the moisture. There is, however, not much advantage in an arrangement of this kind; a thin sheet of Hill's Stopping placed in the joint, makes a better adaptation than the gold, and collodion or a solution of chloroform and gutta percha may be used for the same purpose. The canal in the root above the pivot should be filled with gold; though, in cases where there is a discharge through the fang, this would not be admissible.

The canal at the orifice is sometimes considerably enlarged by decay, so that when the crown is fitted, and the canal sufficiently opened for the reception of the pivot, there will be a cone-shaped space which the ordinary pivot will not fill. There are several methods of obviating this difficulty; one of which is, completely to fill the enlargement with gold, and then perforate this filling with the proper-sized drill for the reception of the pivot; or, which would be better, to introduce into the canal a polished steel wire of the size of the intended pivot; round this consolidate a filling of gold, having first made retaining points at the proper places in the dentine; finish perfectly flush with the end of the root; and then withdraw the wire from the canal, and it is ready to receive the pivot with the crown attached. Some operators form the wood pivot of such a shape as to fit into and fill the enlarged cavity. An other method is, after the pivot is fastened into the crown, to build round it, on the base of this, a portion of Hill's Stopping, of about the size and form of the enlargement in the canal; and then, the tooth being ready to insert, to soften the stopping by heat, and introduce carefully into place. This, when skillfully performed, is probably as good a method as any other.

It frequently happens, in cases where the nerve has been dead for a considerable time, that there is more or less discharge through the canal of the fang, hole in the crown a piece of pivot wood—cut it off even with the base of the crown, and perforate it with the proper-sized drill for the reception of the metal pivot, which may be roughened, or barbed on some of its sides, and then forced into the place prepared for it. An other method is, to drill into a block of wood; insert the pivot, prepared as above, then dress down the wood round it till this will fit closely into the crown; and, after it is pressed in, cut off the protruding portion of wood. In either of these methods, when the wood becomes moist, the metal pivot will be very firmly retained. This pivot may also be firmly attached to the crown by soldering: place the edge of the tooth in plaster of Paris; set the pivot in its proper position in it; fill round this with fragments of gold plate, and put on solder and borax; heat up with a blowpipe, and draw the solder to the bottom of the cavity. An other method, sufficient for all practical purposes, is, to set the pivot in place, and, packing round it a stiff amalgam of gold and mercury, evaporate the mercury by heat. A better method than any of these is, to have teeth manufactured with a platinum tube inserted, into which the pivot can be soldered. Pivots may also be attached to the ordinary plate teeth.

For attaching the metal pivot to the root, it is sometimes fitted tightly to the canal, and introduced into it without any other substance. This is objectionable, on account of the wearing of the root, certain to take place, if there is the least jarring or moving of the crown. To obviate this, various methods have been devised; one of which is, to wind floss silk about the pivot before introducing it; but this soon becomes offensive, and requires very frequently to be renewed. An other method is, to introduce a piece of wood into the fang, and drill through it for the reception of the pivot, which is squared and roughened — squared to prevent it from turning round, and roughened to secure it from drawing out. But if it is desirable to remove the tooth occasionally, the pivot should not be barbed.

Metal tubes may be introduced into the fangs for the reception of the pivots. These tubes are made of hollow gold wire of proper size; the method of preparing which, is, to take a piece of No.-30 gold plate, from four to six inches long, and from a third to a half an inch wide, and bend it round a piece of smooth polished steel wire of the size of the intended pivot; draw both together through a drawplate, down to one size larger than the hole in the fang; then take out the wire, and solder up the tube; on it cut a fine thread with a screwplate; from it cut off from a half to three fourths of an inch in length, and insert into this a piece of the wire it was drawn upon; grasping this section with a small vice or pair of nippers, screw it carefully into the root; and, having introduced it far enough, withdraw the piece of wire, cut off the protruding piece of tube with a fine saw, and file and neatly polish. The root is thus ready for the reception of the crown, the pivot of which should fit very accurately into the tube. A very slight inflection of the pivot will enable it to retain a very firm hold in the tube. The tube's inner end may be soldered up if desirable; and, if there is decay at the orifice of the canal, a flange may be soldered on to its outer end, flush with the end of the root, and the decayed cavity filled beneath it, the flange serving to retain the filling perfectly in place. These tubes can be best fitted in with the screw, though they are sometimes placed in without this, and foil packed about them to retain them. They may be made to receive a square pivot, by being drawn, in their manufacture, on a square wire, in stead of a round one. For the escape of pus, as already referred to, the pivot may be made of hollow wire, with a hole through the crown of the tooth.

A plate tooth, with a metallic pivot attached, may be used in stead of the ordinary pivot tooth; and it is in some cases required, on account of the manner in which the teeth antagonize. But in all cases where a plate tooth is used, it should have a metallic base to rest on, and cover the end of, the root. Properly to construct this, an impression must be obtained, and models and countermodels made, and the base swaged; and then to this the pivot and tooth are attached. Irregularity of the teeth, and especially of the root on which the crown is to rest, may require a peculiar adjustment of the pivot, which may be very happily effected by the method just referred to.

Occasionally, bad consequences follow the operation of inserting a pivot tooth, the most frequent of which is, inflammation of the periosteum. Rough manipulation is very liable to induce this condition, where there is an inflammatory diathesis; in which case, too great care can not be recommended; and prior treatment will sometimes be advantageous. After periostitis has supervened, either constitutional or local treatment, or both, may be employed; constitutional, by emetics and saline cathartics, and, indeed, any agent that will equalize the circulation and counteract the inflammation; and local, by the same means as already prescribed for periostitis elsewhere—in addition to which, it may sometimes be necessary to remove the crown and pivot from the root. It is always important to commence the treatment of such cases at the first indications of the disease.

Sometimes, even with considerable care, a crown will be split by the introduction or the expansion of the pivot; in which case, of course, an other tooth must be selected. When a pivot breaks off, and a portion adheres in the fang, this may be drawn out with pliers or a pivot-extractor, or, if it does not protrude enough for this, it may be drilled out. A fang is sometimes split by the expansion of a tightly-fitting pivot, or by a blow on the crown of the tooth; and when this happens, it must be removed, since it can not be made any longer to retain a tooth. Pivot teeth should seldom, if ever, be worn in a mouth in which teeth on plate are worn. In any case, indeed, they are now far less frequently worn than they formerly were, because, perhaps, of the improved methods of inserting teeth on plate. Under favorable circumstances, however, they may be worn with great comfort and usefulness, from five to fifteen years.

CHAPTER XI.

EXTRACTION OF TEETH.

GENERAL REMARKS.

THE extraction of teeth is an important operation, requiring, for its proper performance, skill, judgment, and experience, as well as an accurate knowledge of the parts to be acted upon. Success in the operation used to be very uncertain; but now, from an increase of knowledge in the art of dental surgery, and from great improvements in the instruments employed, the operation is generally attended with success. The ancients were not strangers to this operation, as is evidenced by relics found in ancient tombs, with teeth absent, under such circumstances as to warrant the conclusion that they were removed by the surgeon. Extracting instruments of very ancient date have also been found; and ancient writers, too, refer to the operation as one not much more pleasant then than now. The demand for this operation rises not from fancy, fashion, or caprice, but from dire necessity—a necessity, too, of great frequency. Very individuals in this country arrive at mature age wit out being required to submit to it; and, indeed, majority, before middle age, lose in this manner fro four to ten teeth, and many, all. The following ar some of the objects for which a resort is had to this operation:—

1. To obtain relief from pain, caused either by disease of the pulp, by inflammation of the periosteum, or by any other affection involving the teeth, that can not be readily controlled without their removal.

2. To prevent pain in future. This, of course, has reference only to those teeth which are very much decayed, or rendered useless by any cause, and which are liable at any time to occasion disease in the parts about them.

3. To save sound teeth from the attack and ravage of decay. This implies those teeth which, by their offensive condition, would prove injurious to healthy teeth.

4. To relieve a diseased condition of the contiguous parts, such as alveolar abscess, neuralgia excited by dental irritation, diseased antrum—and sometimes, indeed, remote parts, which are in many instances affected by diseased teeth.

5. To anticipate and obviate irregularity. Of this there are many cases, in which all the teeth can not

be accommodated with a proper position in the arch, and in which the removal of one or more of them, for this purpose, becomes a necessity.

6. To prepare the mouth for a proper reception of artificial teeth on plates. Though plates are sometimes inserted, with the roots of teeth remaining, yet a perfect operation can never be effected without their removal.

Before anything else is done, every case presented should be carefully examined, in order to ascertain all the circumstances and conditions that might in any way affect the operation. It is important to arrive at a correct conclusion in regard to the tooth or teeth to be removed; the number of fangs, their inclination, and the character of their attachment; in what manner, and to what extent the surrounding parts will be affected by their removal; and the probable amount of force necessary for this purpose. The operator will, in many instances, be referred to the wrong tooth; for a sound and healthy tooth is sometimes painful from sympathy, and, standing in contact with a decayed and painful one, makes it many times difficult for the patient to determine in which the pain exists; and sometimes difficult for the operator, too, especially where the decay is on a proximal portion of the tooth, and not easy of approach. In all such cases, great care should be exercised, and a thorough examination made. There is often extensive decay on the proximal portion of the tooth, that is not apparent at first view.

The constitution is also to be noted—its peculiarities, tendencies, and susceptibilities; as these will often modify the operation. A highly nervous temperament will not endure an operation that one of a different character will undergo with impunity. There may also be idiosyncrasies and conditions that will forbid the extraction of a tooth. One of these, and not the least formidable, is a hemorrhagic diathesis.

The manner of performing the operation is an important consideration: it should not be precipitate or hurried. A very good criterion is, that the eye should critically follow, and the mind attentively comprehend every movement of the hand and instrument. It is a very common method, to seize the tooth, turn away or shut the eyes, and make the most rapid motions possible, regardless of consequences. Accidents, such as breaking of the tooth, fracturing of the alveolus, laceration of the soft parts, and rupture of the bloodvessels, are very liable to follow such a hurried execution; and there are many cases on record, in which injury has resulted from a rapid application of force in the extraction of teeth. The ancients were cautious in this particular: it is recorded of them, that they made extracting instruments of lead, to prevent injury from the employment of too great force. It is difficult, indeed, always to determine what amount of force may be necessary for the removal of a tooth in any given case; though by long and close observation, it may be pretty accurately calculated; and it is important for the operator to know it, so as to prepare for the emergency, and to select the instrument appropriate to the occasion. In order to be successful, an operator must be confident of his ability, and, to be so, must be possessed of it. He should be familiar with the anatomical structure of the parts to be operated upon; should understand the physiological and the pathological conditions of the parts adjacent; and should properly appreciate their influence on, and their connection with, the teeth.

There is a great difference in teeth with regard to their facility of removal. Those most difficult to extract, possess the following peculiarities: shortness and thickness of crown; in the incisors, thickness—the edges of the superior and the inferior meeting squarely on, or deviating but little from their points; freedom from prominences on the crowns of the molars and bicuspids, their masticating surfaces being smooth; regularity in arrangement, all being in correct position and in contact with one an other; color slightly yellow; denseness and thickness of alveolus; unyielding firmness of the soft tissues; lack of prominences on the gums to indicate the size and position of the fangs. An other class of teeth, differing in characteristics from those of the above, are also very difficult of extraction, namely: those having crowns of medium length and of a diameter at the neck much less than at the masticating surface; fangs long and divergent, and in some cases considerably curved; sometimes an osseous attachment, and often a very firm union with the alveolus, even where there is no bony attachment, so that a portion remains adhering to the tooth when it is extracted; which occurs more frequently with the superior cuspid teeth than with any others; and often the septum between the fangs is so firmly embraced by them, especially when they converge, that it is brought away with the tooth on its extraction. Bony union of the teeth has been enumerated as one of the occasional obstacles in extraction of the teeth; but this is of so very rare occurrence—the mode of development almost precluding the possibility of its existence—that it need scarcely be reckoned. Exostosis of the fang sometimes renders extraction very difficult, especially when the enlargement attaches to the point of the fang, and forms a bulb larger than the diameter of the root elsewhere. It is then like a ball in a socket, and, if the walls of the alveolus are thick and firm and closely embrace the fang, the tooth is very securely retained. Exostosis of the same extent in the inferior as in the superior teeth, will render the latter the more difficult to remove, because of the greater density of the inferior maxilla; and it has been maintained that this cause would produce a like difference even in the normal condition of the organs; but experience does not warrant the opinion. The superior molars have more numerous and more divergent fangs than the inferior; and the fangs of the anterior superior teeth are much larger, and consequently have a greater amount of attachment, than the anterior inferior ones. In a healthy condition, the periosteum of the fang has comparatively little sensibility; but in proportion as it is subjected to acute disease, is the sensibility, and thus the pain consequent on the removal of the tooth, augmented.

Instruments adapted to all the different forms and locations of the teeth, are requisite in the various operations of extraction. It is impossible to remove all teeth in a proper manner with but three or four instruments, as recommended by some.

For any kind of successful manipulation in the mouth, and especially that involved in the extraction of teeth, the patient should be placed in such a position as to make him the most comfortable, and to secure to the operator the greatest facility of execution. But different positions, of course, will be required for the removal of different teeth. Finally, there should be as little show of preparation and as little display of instruments as possible—thus to avoid exciting the nervous apprehensions of the patient; and the operator should at all times exhibit a gentle and encouraging deportment, yet work promptly and surely.

INDICATIONS FOR EXTRACTION.

The most common and imperative indication is, continued and violent toothache. In all cases where the teeth are diseased and painful, and can not be restored to health, they should be removed. There are, however, few cases of diseased teeth, that cannot be relieved by the present methods of treatment, so as to remain in the mouth with some degree of comfort and usefulness. Alveolar abscess terminating on the outside of the face, or tending to it, always indicates the removal of the offending tooth. Chronic inflammation of the investing membrane used to be considered an indication for extraction; but it is found that many cases thus affected, may, by judicious treatment, be restored to comparative health. Ulceration of the investing membrane clearly points to extraction as the remedy. Teeth that have no antagonists, and that, on this account, keep up an irritable condition in the contiguous parts, should be removed; and so, as a general rule, should supernumerary teeth. In order to relieve a crowded condition of the teeth, it is sometimes necessary to remove one or more, even though they may be healthy.

Till within the last few years, the existence of an alveolar abscess was considered an indication for the removal of the tooth from which it proceeded; but, under the present mode of treatment, except in very aggravated cases, a simple abscess is not reckoned a sufficient cause for extraction.

The posterior teeth may be removed for causes that would not warrant a removal of the anterior. All dead teeth and roots that produce or keep up irritation, should be removed, especially if the tendency is persistent.

The temporary teeth that are not cast at or near the time their respective permanent teeth should appear through the gum, ought to be removed; but caution must always be exercised, lest they be removed too soon. Painful and uncontrollable disease may indicate their removal long before the period just mentioned; yet they should not be removed on account of diseased condition, unless the rudiments of the permanent teeth are likely to suffer thereby. A crowded condition of the permanent with the temporary teeth, may indicate the removal of one or more of the latter. It is important to understand the true indications for the removal of temporary teeth; in these, as in the permanent teeth, apparent indications are liable to be mistaken for real ones. Teeth may sometimes, even though undecayed, produce nervous affections, and in such a manner as to render their removal necessary. This indication is most frequent with teeth affected by exostosis.

A high state of inflammation in the contiguous parts, is regarded by some as a counter indication; but it can be such only in cases in which the inflammation would be increased by the operation; and this would happen only where there is a decided inflammatory diathesis; which peculiarity can be readily detected by a little carefulness of observation.

EXTRACTING INSTRUMENTS.

Numerous and various instruments have been employed for extracting teeth; and each of these has passed through various modifications. Imperfection and inadaptation have, till within a few years, characterized them all in a marked degree, as indicated by the numerous changes they have undergone. Two general classes comprehend them all — represented by the key and the forceps. The former makes its attachment on one side of the tooth, coming in contact with but a small portion of it, and has a resting point for a fulcrum on the adjacent parts, the gum and the alveolus. The latter embraces the tooth on both sides, and has no fulcrum resting on the adjacent parts. There are other instruments somewhat different from these in their application; but the principle on which they operate, is the same. For instance, the elevator has a point of embrace or contact with the teeth, and a fulcrum or resting point, on the adjacent parts, the power being applied to the handle, as to a lever. The screw makes its attachment inside of the tooth, instead of outside, like the forceps, and does not touch any other part.

There should always be at hand a sufficient number and variety of instruments to meet every case, however rare its occurrence. Desirabode recommends the employment of but four instruments for the removal of all the teeth: the first is a forceps, and the other three are nothing more than so many different forms of the elevator. He was not familiar with the present improvements in extracting instruments, or he could not have made such a recommendation.

THE KEY.

The principle of this instrument was, at a very early period, brought into requisition for the extraction of teeth; it is, emphatically, an old instrument. It consists of a shaft six inches long, with a handle four inches, attached at right angles, while the hook is attached laterally at the other end of the shaft, and the bolster, either movable or fixed, to the side

of it, immediately below the articulation of the ho
This instrument has passed through a great variety
forms and modifications; having the shaft straig
curved, double-curved; the fulcrum large, small, fl
round, long, short, fixed, movable, and anterior, p
terior, or opposite to the point of the hook. Th
has also been a great variety of forms of the hoo
and it has been made with machinery attached,
control its grasp, the object of which is, to preve
the instrument from slipping off the tooth, and sk
in the use of which would doubtless add to the e
ciency of the instrument. The principle of t
forceps, too, has been combined with the key, a
probably with very decided advantage.

The *modus operandi* of the key is worthy of so
consideration. The hook is attached to the sh
directly above the bolster, and starts off at ri
angles with its vertical axis, but curves down to t
point, almost or quite as low as the base of the bolst
When properly constructed, the hook embraces t
tooth at the neck on one side, and the bolster rest
little below this on the other. When the instrum
is applied to a tooth, the center of the shaft is t
axis of motion; but, as force is applied to the inst
ment, this axis is transferred from the shaft to t
base of the bolster, which is the center of motion t
moment it is fixed on the gum and alveolus, and t
shaft describes an arc about it. Now, as a result

in the operation, on the gum, on which it exerts great pressure, and which it always bruises, and frequently lacerates in a cruel manner; and the degrees of pressure exerted by the bolsters of the variously constructed keys differ but little; though, perhaps, the bolster which has a broad base, and which is attached to the shaft by a joint, would cause less pain to the patient by its pressure, and be much less liable to lacerate or cut the gum, than the small and permanent one. The pressure of the bolster on the gum and process is always greater than the power required to extract a tooth; and this extreme pressure and its consequences constitute an other strong objection to the use of this instrument. The power being applied at a disadvantage, much more of it is required than when economically applied.

This instrument is so seldom employed for the extraction of teeth, that any very special directions as to its use will scarcely be required; yet a few leading suggestions may not be out of place. Whether a tooth should be drawn inward or outward depends on its position and inclination. As a general rule for the removal of the molars, the bolster should be placed on the inside of the inferior teeth, and on the outside of the superior. For removing the lower teeth of the left side, the operator should stand at the right of the patient; and for the teeth of the right side, in front or at the right. For the inferior teeth of the right side, he should stand at the right of the patient; and for the left superior, in front of him. There have been a great many different opinions as to the manner of applying and using the instrument. One recommends that "the teeth should be always turned towards the tongue." An other, "that the fulcrum should be so placed that it would not come in contact with the tooth." An other directs: "Place the fulcrum on the margin of the gum." An other: "Place the fulcrum on the gum below its margin." An other suggests, "that the fulcrum be placed on the side of the tooth opposite the point of the hook." Again, we are directed "that the tooth should be drawn from the higher alveolus." This great diversity of opinion as to the manner of using the key, as well as the great variety of changes in its form, is evidence that it is, at best, a very imperfect instrument. It is impossible to embrace a tooth as deep with it as with well-constructed forceps; and with it, the chances of accident in the extraction of teeth, are much greater than with any other instrument. A strong advocate of this instrument says that "the key *always* produces injury; but the greatest skill exhibits the least injury."

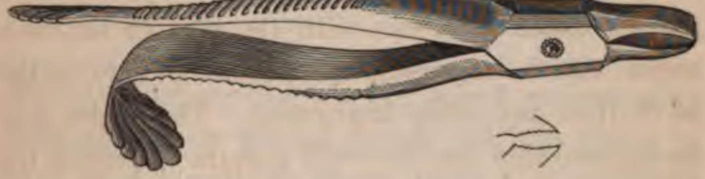
FORCEPS.

The forceps are the most efficient extracting instrument in use; and the improvements made in them during the last few years have been very great; indeed, twenty years ago, they were not made with any special adaptation whatever, and were totally unfit to be used for the extraction of teeth; but now, they are constructed with such various shapes and curves as to facilitate their approach to teeth having any position in the mouth, and to fit all the forms of the points, and make the most perfect embrace of the tooth possible. Forceps, with the present improvements, take a deeper and more thorough hold on the teeth than any other instrument. The beaks may be made so thin that they will penetrate between the fangs and alveolus, and the adaptation so complete that the instrument will not slip its hold on the tooth at all. The form of the beaks should be such as to fit the crown without pressing on it, and yet perfectly embrace the neck of the tooth; and the entire instrument of such form and curve as to give to the hand, arm, and body of the operator the best position for ease and facility of execution.

There are various opinions as to the position relative to the patient which the operator should occupy while extracting teeth with the forceps. Some recommend different positions for the removal of different teeth; but it is preferable, on many accounts, to occupy as nearly as possible the same position in the removal of all; and this is at the right and a little back of the patient.

The forceps for removing the superior incisors are straight, and have thin beaks, which are sufficiently broad to embrace the anterior and the posterior surfaces of the teeth entire (Fig. 39); and they should be much broader for the centrals than for the laterals.

Fig. 39.



The points should not be so broad, however, as to come in contact with the contiguous teeth in the rotary motion made to break up the attachment. The same principle in regard to the width of the forceps is to be observed for the lateral incisors and cuspids. The ordinary straight root forceps may be employed for the extraction of the lateral incisors; though, for this purpose, it is desirable that their beaks be somewhat thinner than usual. For the superior cuspid teeth, the ordinary bicuspid forceps are frequently used; but their beaks are commonly too narrow, and those of the central-incisor forceps too thin. The cuspid forceps should be about as wide as those for the central incisors, with the thickness of the bicuspid forceps (Fig. 40), and with a greater concavity, so as to fit the neck of the tooth. Superior bicuspid forceps have narrow, thick, and quite concave beaks, and the instrument is straight, or nearly straight; though for the second bicuspids, especially in a small mouth, it should have some anterior curvature. (Fig. 41.) One pair of forceps will serve for both sides, though it is desirable to have one for the first, and an other for the second bicuspid. For the removal of the bicuspids, there is a kind of forceps with thick, smooth beaks, and of such a form as, by pressure, to force the tooth from its socket, taking advantage, for this purpose, of the conical form of the root. The superior molar for-

Fig. 40.

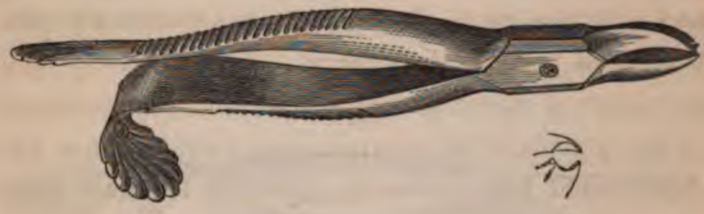
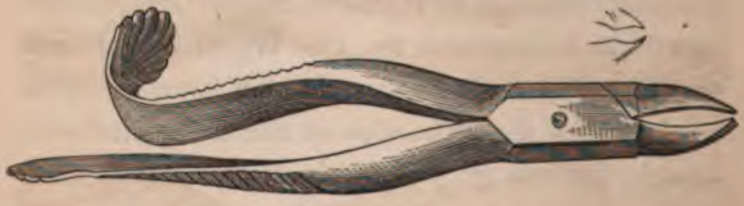
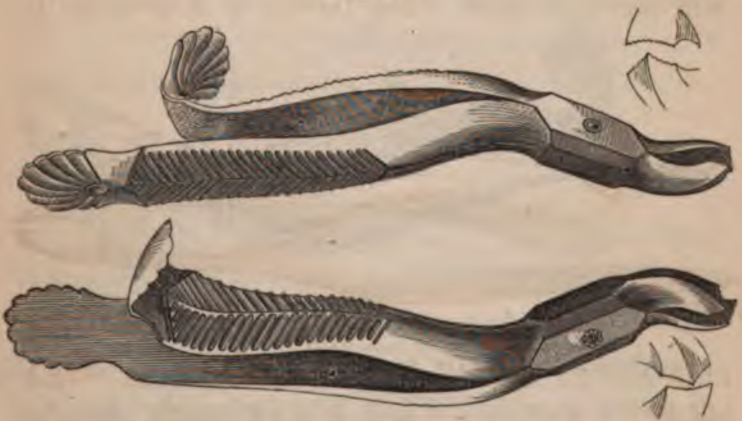


Fig. 41.



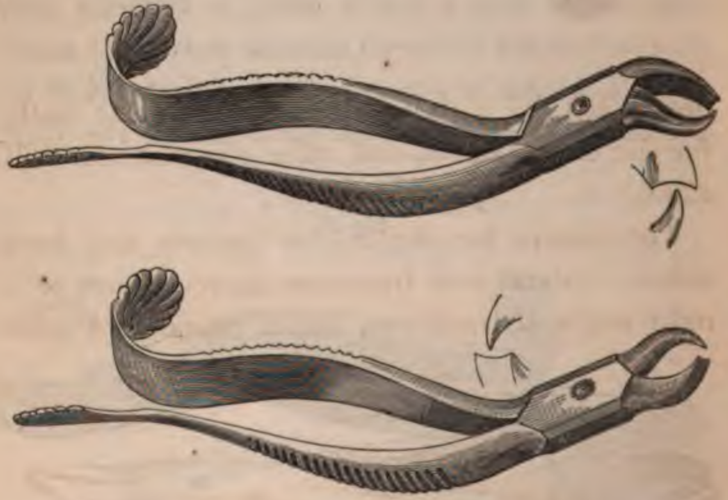
ceps, a pair for each side, have one of the beaks a single concave, to embrace the palatine fang, and the other a double concave, with a projecting point from the center of the beak, to pass into the bifurcation, and with the edge of the beak so formed as to embrace the two palatine fangs. The concavity and curvature of the beaks should be first just sufficient to accommodate the crown of the tooth. These forceps should have a double curve, to facilitate their approach to the teeth—an anterior curve just above the joint, and a downward curve just below it; sometimes, also, a lateral curve above the joint, throwing the instrument more toward the angle of the mouth. (Fig. 42.)

Fig. 42.



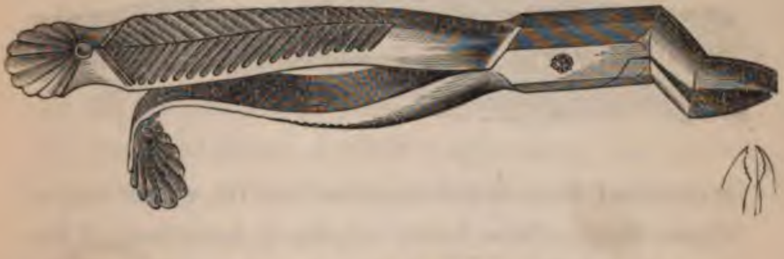
For the second molars, the forceps should have a little more curve above the joint, than for the first. A third pair of forceps for these teeth, and especially for the roots before they are separated, have the inner beak similar to the one above, and the outer a curved, attenuated, sharp point, to pass between the buccal fangs (Fig. 43). The forceps for the superior *dens sapientiæ* have two single-concave beaks, made to embrace the tooth, as though it were cylindrical, or nearly so, at its neck. The instrument has two curves, or rather angles, the one forward, and the other downward, so that its handle is somewhat anterior to, but almost parallel with, the axis of the tooth. (Fig. 44.) It is a principle that should be

Fig. 43.



observed in all forceps, that the handle be as nearly parallel with the axis of the tooth as possible, and as

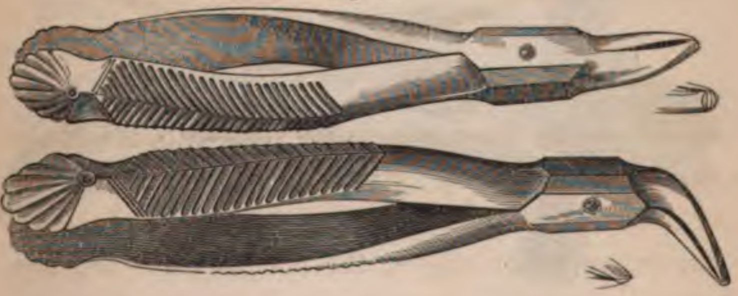
Fig. 44.



nearly in a line with it as the location of the tooth, the size of the mouth, and other circumstances will admit.

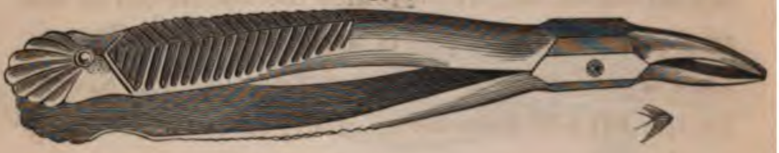
The forceps for the inferior incisors may have either a lateral or a transverse curve—almost to a right angle, if transverse, but if lateral, not more

Fig. 45.



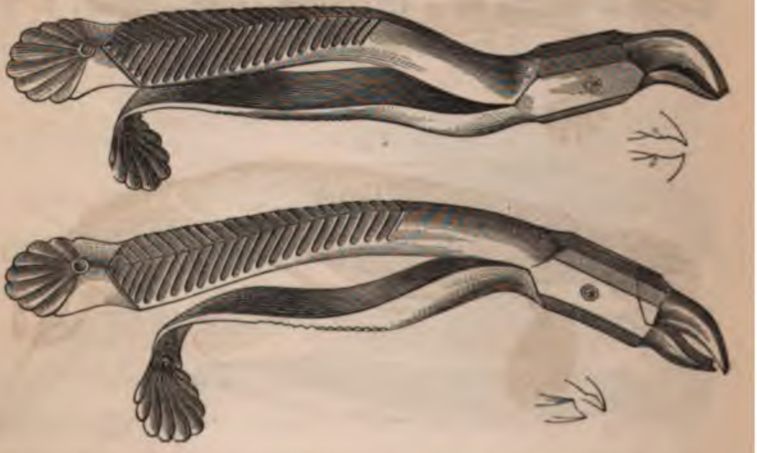
than half that inclination. (Fig. 45.) The ordinary, slightly curved root forceps may be used for the extraction of these teeth. (Fig. 46.) The beaks should be very narrow and thin; for a great

Fig. 46.



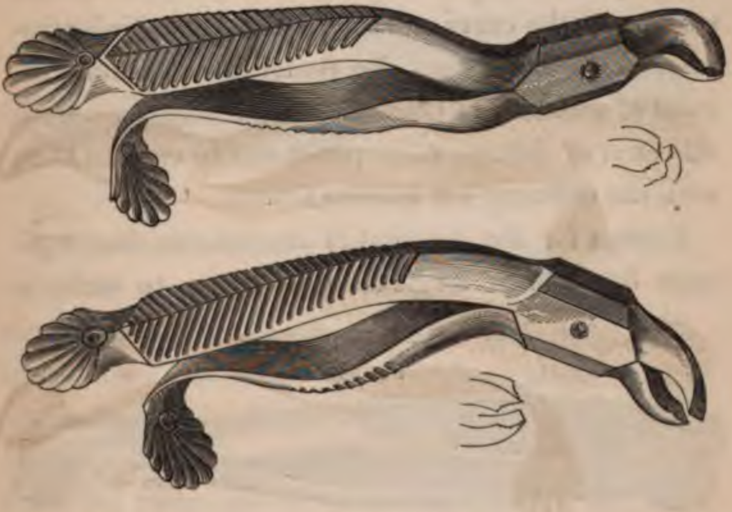
amount of force is not required for the extraction of these teeth. The beaks of the inferior-incisor forceps should be relatively broader than those of the forceps for the superior incisors. Rotary motion in the extraction of inferior incisors, is not admissible.

Fig. 47.



The inferior-bicuspid forceps are well adapted to the removal of the cuspids also. These forceps, two in number, one for each side, are of different forms. (Fig. 47.) The beaks are narrow, thick, and quite concave. The instrument for the right side has a lateral curvature, which brings the handle out at the angle of the mouth, and is necessary in order to obviate a contact with the superior teeth. The forceps for the left side have beaks of the same form. They are bent to almost a right angle above the joint, while below it the handle is thrown upward; and their inner beak is longer than the outer. The inferior-molar forceps are two in number, that for the

Fig. 48.

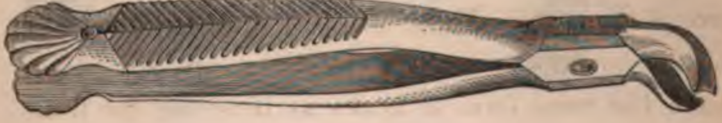


right side being curved outward and forward, and that for the left forward and upward, the beak making almost a right angle with the body of the instrument, and the inner beak of each being longer than the outer. The beak should be of sufficient breadth to embrace the entire side of the tooth, of double-concave form, with a ridge and a long point in the center of the beak, to pass into the bifurcation of the fangs. The inner beak of these forceps should be longer than the outer; for the teeth on which they are designed to operate, have an inward inclination, and the outer alveolus is higher than the inner. (Fig. 48.)

A pair of forceps for the left side, similar in form to those for the right, would be preferable to the ordinary left forceps, when the mouth can be opened wide; and the curvature of the handle of this instrument would be toward the center of the mouth, instead of outward, as that of the right forceps. With this form of forceps, more power can be exerted than with the ordinary left inferior forceps.

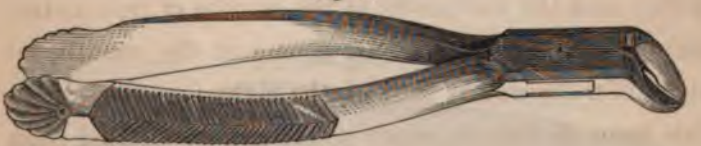
Forceps for the removal of the inferior *dens sapientiæ* have large single-concave beaks, to make a general embrace of the tooth, and have but one curve, which is between the joint and the point, and is

Fig. 49.



almost a right angle. (Fig. 49.) One pair of forceps of this kind is quite sufficient for both the right and the left side. The forceps denominated *Physic's forceps* are also sometimes employed for the removal of the wisdom-teeth. These are constructed with thick, sharp blades, the edges of which come squarely together, and the points sometimes have an enlargement on them. They are curved almost to a right angle: without this curve, the edges would be parallel with the handle. (Fig. 50.) There are two or three different forms of Physic's forceps.

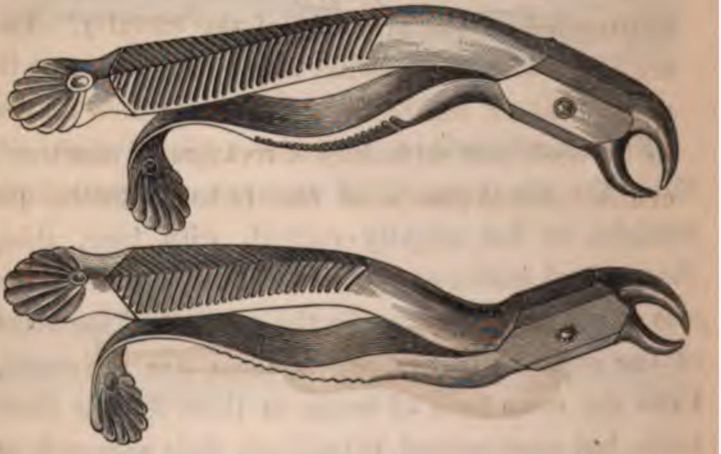
Fig. 50.



Of the considerable variety of root forceps now used, those for the removal of the anterior teeth, are straight, or but slightly curved, with long, thin, sharp-edged beaks, and of a width regulated by the size of the roots. Those for the removal of the roots of the superior molars, when these are separated, have the same form of beaks as those for the front teeth, but more curved, to facilitate their approach to the roots. For the removal of these roots, it is well to have several pairs of forceps with different degrees of curvature, using, in any given case, those with the least admissible curve—which, in a small mouth, will be considerable, while in a large one, it will be very slight. The same forceps that are used for the removal of the front inferior teeth, are applicable to the removal of their roots.

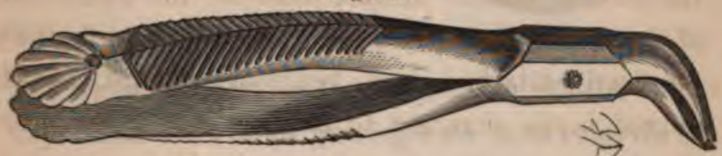
Of the different forms of forceps for the removal of the roots of inferior molars, those for the extraction of the roots before they are separated, and while they are firmly attached, have two long, slender, round, curved beaks, designed to pass down deep between the two roots; their curvature should be almost a right angle, and their handles assume the form of the ordinary right and left inferior-molar forceps, already described (Fig. 51); or, if but one is used,

Fig. 51.



the handle should be straight. The forceps for the removal of these roots after they are separated, should have the beaks of the same form as those of the superior-root forceps; but the beaks should be curved to a right angle with the handle, and the handle be straight. (Fig. 52.)

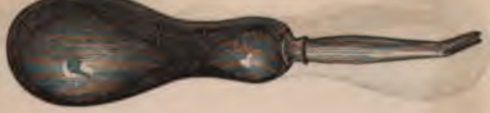
Fig. 52.



ELEVATORS.

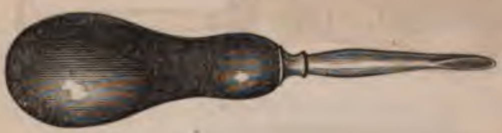
There are in use variously formed instruments constructed on the principle of the elevator. They are made with such points as to take the most thorough hold on the teeth or roots on which they are to be used, and with such curvature of shaft as to enable them to pass most readily to the desired position. Some are so formed at the points as to embrace the root at the border of the alveolus, using

Fig. 53.



the latter as a fulcrum (Fig. 53); others, to pass between the alveolus and the root (Fig. 54); others, to çut through the alveolus, and thus approach the

Fig. 54.

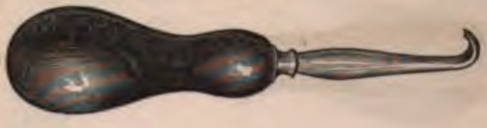


root. All the ordinary elevators make a fulcrum of the alveolus or of an adjoining tooth; but some operators, in using this instrument, contrive to make a fulcrum of the thumb or one of the fingers; which is the preferable way.

HOOKS.

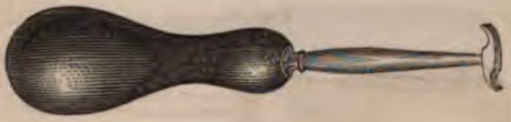
These are formed so that the point shall embrace the root and remove it, without any rest on the surrounding parts. The root is removed simply by

Fig. 55.



pressure, applied in the proper direction. Of the various forms of this instrument, there are the forward hook, the backward (Fig. 55), and the compound (Fig. 56), which last includes the former two.

Fig. 56.

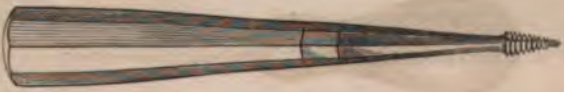


These are valuable instruments, but require care in order to avoid injuring the surrounding parts.

SCREW.

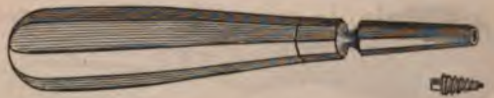
This is a cone-shaped instrument, with a very definite, sharp screw-thread on it; and the manner of using it in the operation of extraction is, to screw it into the fang. It will be required to be of various sizes to correspond with those of the different roots to be extracted. It is commonly attached to the handle by a permanent shaft (Fig. 57); but, sometimes, it is made with a square shaft fitted into a socket handle (Fig. 58), by which arrangement the

Fig. 57.



handle is used only to introduce the screw; and this serves only as a support to a frail root, the forceps

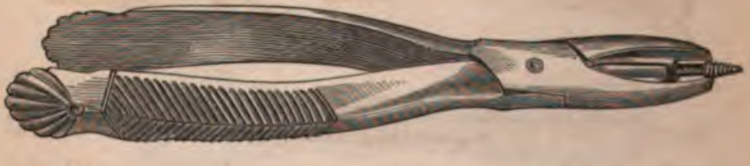
Fig. 58.



being then brought to bear, in connection with it, for the removal of the fang. A screw-top, of the same form as the screw, should accompany it.

When the screw is combined with the forceps, for the purpose of supporting the root and preventing it from crushing while it is removed with the forceps, the latter is of the same form as that of the ordinary straight-root forceps, with the shaft of the screw attached in the joint. In some, the screw is attached with a spring and ratchet, so that it can be drawn out, seized between the beaks, and introduced into

Fig. 59.

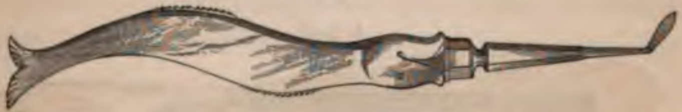


the root; and then these are slipped on the root, which they embrace and remove. In others, the screw is fixed; but the movable screw is to be preferred. (Fig. 59.) An arm bearing a pad, to rest as a fulcrum on the other teeth, is sometimes attached to the shaft of the screw; but this is objectionable because of its liability to impede the action of the instrument, and also to injure the adjoining teeth.

GUM-LANCET.

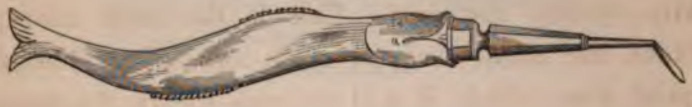
Of the various forms of the gum-lancet, the most common is that with the round point, and with the blade from two to four lines wide, and from half an inch to an inch long, attached to a shaft and handle; the whole being about six inches in length. The instrument should have a keen edge on the sides, two or three lines from the extreme point. It is sometimes made with the edge square; but the round edge is the better form. The edge is parallel with the handle in the ordinary lancet. (Fig. 60.) This form is used for separating the gum from the buccal and palatal surfaces of the tooth. A lancet with the edge transverse to the shaft is required for separating the gum from the proximal portions of the teeth. The blade of this should be of the same general

Fig. 60.



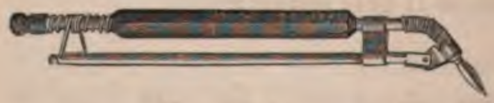
form as that already described, except that it should be quite narrow—in no case more than two lines wide. (Fig. 61.) Gum-lancets are made with the blade set in a socket on the end of the shaft, so that it can be rotated and set to any angle, to meet every case.

Fig. 61.



A very ingenious instrument, invented by Dr. Merry, and denominated "Merry's Revolving Gum-lancet," has recently been brought to the notice of the profession. This is a very excellent instrument—superior, indeed, to any thing else of the kind. (Fig. 62.) The following is a description of it: "It consists mainly of two shafts: one is round and small; the other is larger, and part round, and part octagon. Just back of the spiral spring which curves down at the lancet end, is seen a piece connecting

Fig. 62.



the two shafts. This piece is soldered fast to the round shaft, while the upper end of it forms a collar, in which the round part of the larger shaft *slides* back and forth, and *revolves*. On the other end of the large shaft is seen a screw, made by winding a wire spirally round it. This is the male screw. From the small shaft rises an other, but shorter spiral wire, which, it will be seen, fits in the male screw. The short one may be considered the female, or nut, in which the other revolves. The ends of the short spiral are soldered fast to the small shaft. If, then, the large shaft is revolved, the screw on it playing in the female, is made to slide back and forth, accordingly as it may be revolved. This motion, then, changes the direction of the point of the lancet to the plane of the shafts, any degree from a right angle to a parallel. Having thus got the inclination which is desired, the blade is inserted into the gum at the point at which the incision is to begin; and as the instrument cuts, rotate the larger shaft slightly, and the blade will follow the outline of the tooth as it cuts round it."

THE METHOD OF LANCING THE GUMS.

In all cases, the gum should be separated from the tooth as far as the embrace of the forceps is to extend; and the lancet should pass close to the tooth, so as to make the separation clean about its neck;—in order to which, the lancet must be kept in good condition;—and it should also be passed freely between the teeth. A complete separation of the gum is essential to a good hold of the forceps on the tooth. Some operators, however, do not use the lancet for this purpose, but tear the gum away by forcing the forceps to its position on the tooth. This method is objectionable on several accounts: it causes the patient much more pain than with a sharp lancet; the forceps can not thus be adjusted to the tooth with so much facility; there is far more danger of lacerating the soft parts, and, because of an imperfect adaptation of the forceps to the tooth, more danger of fracturing this; and the operation is always more difficult of accomplishment. In those cases in which the gum is firm and tense, and would obstruct the free passage of the forceps to the proper position on the tooth, it is sometimes necessary to make a vertical incision of the gum, even after it has been separated, directly opposite the fang. But it is in many instances better to cut away a portion of the free margin of the gum, in the extraction of roots that are partially covered by it; and there is no objection to this method in any case where it may at all facilitate the operation; for this portion of the gum, if let remain, is always absorbed away after the extraction of teeth. It is also sometimes necessary to dissect the gum somewhat from the alveolus in those cases in which a deep hold on the tooth or root is required, and in which the alveolus is either cut away or embraced by the forceps. The character and condition of the tooth will somewhat modify the extent to which the gum-lancet should be used.

EXTRACTION OF THE TEETH.

In the following remarks, it is the design to consider only those principles obviously involved in the extraction of the teeth with forceps, and in the extraction of roots with forceps, elevators, and screws.

Superior Incisors.—After an examination, the gum, as in all cases, should be perfectly separated from the neck of the tooth, up to the border of the alveolus: this is quite sufficient, if the tooth is not too much decayed. With the forceps already described (see Fig. 39), grasp the tooth firmly at the border of the alveolus; introduce the instrument slowly, adjusting it carefully, as it passes up to the proper position; then, by a gradual movement, rotate the tooth in the socket, thus breaking up the attachment. All the cylindrical, single-fang teeth may be luxated by a rotary motion. There are occasional circumstances, however, that render this somewhat difficult,—as, for instance, any considerable curvature of the root; or, sometimes, the attachment to the outer plate of the by the inward and outward movement, which, on account of the pressure made on the parts, is attended with much more pain, and far grea danger to the contiguous parts, than the loosen by rotary motion.

The roots of the incisors are not difficult to remo unless being very much decayed, they will not with the embrace of the forceps below the border the alveolus; and when they are thus decayed, of the following methods may be adopted: the g may be dissected on the alveolus, and the latter away with the thick cutting instrument, so as expose the root sufficiently for extraction with root forceps; or, after the gum is dissected up, alveolus and the root may be together embraced, the former broken away with the latter. This i rather rough method of operation, though it is of adopted. Or, an elevator of the proper form may introduced between the root and the alveolus, the root thus dislodged.

The screw, either simple or compound, is a valua instrument for the removal of these roots. But gum should be separated even when the extract is to be accomplished with this. The canal in the root should first be enlarged with a taper drill, of the same shape as the screw, till all the softened dentine is removed. Then the screw, selected of proper size, and with a very sharp and firm thread, is introduced till it takes a strong hold in the solid dentine, especially if it is the simple screw. In some instances, while it is being introduced, the root will be loosened. In using the screw in connection with the forceps, it is not necessary to introduce it with the same firmness as when the screw alone is employed. In the use of the screw-forceps, the screw is embraced in the beaks, and introduced; then, the forceps are passed up on the root, or between it and the alveolus, if need be, the screw serving to sustain the root under the pressure of the forceps. The attachment of the root is broken by a rotary, or an inward and outward movement, as the case may require.

Superior Cuspids.—For the removal of these teeth, the central-incisor or the bicuspid forceps may be used; though usually, the beaks of the former are too thin, and those of the latter, too narrow. The forceps appropriate for the removal of these teeth, have broad, deep, concave beaks, so as to embrace the tooth as completely as possible; and they are thick, so as to possess sufficient strength. The gum being separated, and the forceps adjusted on the tooth, the attachment is broken up, either by an inward and outward, or by a rotary movement; the former will be far more frequently brought into requisition, since these teeth are generally so firmly attached that they can not be loosened by the latter; but the skillful and experienced operator will often combine the two, with the happiest effect. These teeth have larger roots than any others in the mouth, and the alveolar process closely invests them; and thus they are very firmly fixed in the sockets, and are also more frequently found curved than the roots of the incisors. Often, in extraction of the cuspids, a portion of the outer wall of the alveolus is broken off, and comes away with the tooth. But this accident is not attended with any serious results; indeed, in the preparation of the mouth for artificial teeth, it is desirable that it be broken away.

The movement in the extraction of a tooth should always be very deliberate—never sudden and violent. A very good criterion in regard to the rapidity of movement, is, that the eye should follow and distinctly recognize every motion of the forceps, the tooth, and the contiguous parts.

The removal of the roots of these teeth is far more difficult than that of the incisors. Frequently the gum has to be separated up two or three lines on the alveolus, and the latter broken in with the forceps, before the root is removed. The compound screw is often very valuable in the removal of these roots—

the simple screw not commonly being of much avail, since the force necessary to extract the root, is generally so great that the screw alone will not take a sufficiently firm hold to accomplish it. The elevator is not a very efficient instrument in the removal of these roots.

Superior Bicuspids.—For the removal of the bicuspid teeth of both sides, one pair of forceps is quite sufficient (see Fig. 41). These forceps are without any curve; though, in a small mouth, for the second bicuspids, a slight anterior curve would be desirable, since it would admit the instrument to a better position on the tooth. These forceps properly adjusted on the tooth, according to the directions already given, the attachment is broken up by an inward and outward movement, carried just to the extent necessary to accomplish the object; and then, traction is applied to remove the tooth from the socket. This application of the force is specially adapted to the first bicuspids. Rotary motion should be very seldom applied to these teeth, because their points generally terminate in a bifurcation, and it is impracticable thus to detach them without breaking off, at least, one of the fangs; and, where these fangs do not bifurcate, they are so much compressed as generally to forbid such a force. Occasionally, however, there is but one fang, and this is nearly cylindrical, as will be indicated by the cylindrical form of the crown and neck of the tooth; and, in such cases, the rotary may be combined with the inward and outward motion. The roots of the second bicuspids commonly terminate in one conical fang, usually somewhat compressed; and, in general, the rotary motion may be combined with the inward and outward in their extraction. There is occasionally, however, some curvature to these roots; but very seldom is it sufficient to cause any difficulty in their removal. The skillful and experienced operator will, in most cases, determine very accurately the size, shape, and position of the fangs by the peculiarities of the crown; and the attention of the young practitioner should be directed very closely to this point, till he is able to arrive at accurate conclusions. For the removal of these teeth, there are forceps with thick, peculiarly-formed beaks, constructed to take advantage of the conical form of the roots. The instrument is placed on the tooth at the border of the alveolus, or, if need be, a little beyond it; and then, the process having been first cut away, firm compression is made on the handle of the instrument, and thus great pressure on two sides of the root,—which are relatively as two inclined planes,—by which the tooth is forced directly from its socket, without either the oscillating or the rotary motion. This instrument is rarely ever applicable to the removal of any other teeth than the second bicuspids, and occasionally the central incisors, and then only when the roots are very tapering. The roots of the bicuspids, especially the second, are usually not difficult to remove. Sometimes, however, the first bicuspids have two well-formed roots, somewhat divergent, that are difficult to remove, especially if the decay has eaten away till there is little of the tooth left for the instrument to take hold upon. But, frequently, if one of the contiguous teeth is absent, a lateral seizure will remove the root at once.

Root forceps with narrow, thin beaks, which may be readily forced between the root and the alveolus, are very valuable for the extraction of all small roots.

The screw, whether simple or compound, is not applicable to the extraction of the roots of the bicuspids.

A bicuspid will sometimes stand somewhat out of the true circle, and the contiguous teeth approximate so that it will not pass between them. In such a case, the principal part of the movement for its detachment should be in the direction of its inclination. The cuspid teeth are sometimes found in the same condition, and a similar application of force for their removal is to be made; indeed, this method is appropriate to all cases where the teeth stand out of a proper position and the contiguous teeth impinge on the space.

Superior Molars.—The first and the second superior molars have each three fangs, one buccal, and two palatal; the palatal being the largest and longest, and the buccal of the first larger than that of the second. The palatal fangs diverge very considerably from the axis of the tooth; while the buccal are often parallel with it and with each other; but they sometimes diverge in both directions. Occasionally, the divergence of some or all of these fangs, is so great that they can not pass out of the socket without either fracturing the alveolus or breaking off one or more of the roots. On the contrary, there is sometimes such a convergence of the buccal fangs, that the intervening portion of bone is necessarily brought away with the tooth. Indeed, the three fangs are sometimes found all in contact, forming an irregular conical root; but this is a condition of unnatural development.

The appropriate forceps being firmly fixed on the tooth, an outward and inward movement is applied, and traction at the same time. In the examination of these teeth, to ascertain the force necessary for their removal, two particulars have to be considered: the firmness of the attachment, and the position and inclination of the roots. When these teeth, as they occasionally do, stand somewhat outside of the correct position, great care must be exercised in their removal, especially if the contiguous teeth impinge.

In small mouths, the contiguous impinging tooth is liable to be injured by the pressure in extraction; but this injury may be avoided by directing the pressure backward. Commonly, the first effort made to break up the attachment, should be outward; except where the tooth stands inside of the circle, or where it is decayed very much on its inner side, while its outer remains firm. In those cases in which the fangs diverge so much that they will not pass out of the socket, without tearing away some of the wall of the alveolus, it would be impossible to break up the attachment by an inward movement; for the palatal fangs brace the tooth, and the inner process is very strong and unyielding. Where a molar is decayed on its proximal sides, and the contiguous teeth encroach on it, so that it can not pass out directly between them, it must either be cut away with the chisel or file till it is small enough to pass, or be drawn to the outside from between.

The decay on the buccal or palatal sides often extends below the gum, and even below the border of the alveolus; or there may be extensive softening of the dentine of the crown; and in either case, the gum and process must be cut away sufficiently to admit a firm hold on the tooth where it is strong enough to sustain the embrace of the forceps.

Extraction of Roots.—The extraction of the roots of the superior molars is not attended with much difficulty when they are separated by decay, or are easily broken apart; the method then is the same as for single roots. They should be deeply embraced with the curved, sharp-pointed root forceps (see Fig. 46), and rotated to break up the attachment, traction being applied at the same time. It is very rarely necessary to resort either to the elevator or to the screw for the removal of these roots. The greatest difficulty is experienced when the bifurcation is deep, and the roots all adhere firmly together. In such case, the same force is required for their removal as before the crown was decayed off. The root forceps, shown in Fig. 43, can be very effectively used in the extraction of these roots. The round, sharp beak is passed between the buccal and the palatal fangs, the other beak embracing the palatal; and with this hold, by an inward and outward movement, the root is removed. These forceps are not applicable where there is but one large conical root. For the removal of roots of this form, the wisdom-tooth forceps, or those with similar beaks, are required. When it is necessary to dissect off the gum, and cut away the process, in order to obtain a firm hold of the root, this should be done in preference to crushing in the process with forceps—except, indeed, it may be the case of a very irritable patient, who will not tolerate a protracted operation; in which case, it is better to complete the operation at a single effort.

REMOVAL OF THE DENTES SAPIENTIÆ.

There is not usually much difficulty attending the extraction of these teeth. The appropriate forceps for this purpose (see Figs. 44 and 49) have two large single-concave beaks, so formed as to embrace the neck of the tooth, without any reference to the bifurcation or the number and position of the fangs. Ordinarily, the attachment of these teeth is broken up by the inward and outward movement; but where a single, round, conical root is clearly indicated, the rotary movement would be preferable, or the rotary in conjunction with the inward and outward. These teeth sometimes stand out of the true position, more frequently inclining outward, as already suggested in an other place; and the direction of the force for their extraction will correspond with this inclination.

Sometimes these teeth are very difficult to extract; and this difficulty is dependent on the following circumstances: first, an anterior inclination of the tooth, so that it stands at a considerable angle with the adjoining tooth, and in contact with its posterior proximal surface, the posterior border of the process being thick and firm, and extending down full on the crown of the tooth; and second, the existence of several fangs, with great divergence, irregularity, and curvature. The removal of a tooth in the first of these conditions is often a very protracted operation, fraught with much pain to the patient and considerable labor to the operator. Such preparation must be made as will permit a free egress of the tooth from the socket, before an effort is made for its extraction. This is effected either by cutting away the portion of process behind the tooth, so that it may be forced backward sufficiently to let it pass out of the socket, or by cutting away enough from the anterior portion of the tooth; or, if the posterior proximal surface of the second molar is decayed, it may be quite as well, and more convenient, to cut this down so as to allow of the egress.

Physic's forceps can be used very effectively for the extraction of these teeth, when they occupy such a position, provided the root is straight, or has a posterior curvature; but if there is an anterior curvature, the tooth is most difficult to extract, and Physic's forceps would be wholly inefficient—except to break off the tooth. In such case, the posterior portion of the process should be cut away as much as possible. Physic's forceps are frequently employed for the removal of these teeth, when they occupy a correct position; but their use is somewhat objectionable, especially in the following respects: the instrument acts first on the principle of a wedge, being forced between the teeth, and then on that of a lever, the second molar being the fulcrum; and hence, when it is employed, the second molar must always be present, and is liable to injury from the pressure which may do violence to the periosteum, or fracture and scale off portions of the enamel. But if the first molar is absent, there is almost as much liability, with the forceps, of loosening the second as of extracting the third. Indeed, it is always objectionable to use a sound tooth, under any circumstances, as a fulcrum for an extracting instrument.

When the roots of a wisdom tooth are irregular in number, inclination, and curvature, a good firm grasp must be taken on it, and then an oscillating force applied, sufficient to remove it from its socket. There is nothing pertaining to the removal of the roots of these teeth that involves any different principle or application of instruments from that given for the removal of the teeth themselves. The anterior inclination which so often renders the whole tooth difficult of extraction, very seldom affects the removal of the roots. These are, in general, easily extracted with the common curved-root forceps.

EXTRACTION OF THE INFERIOR INCISORS.

In the extraction of these teeth, either of the forceps described for the purpose, may be employed. The beaks should be quite narrow and thin (see Fig. 45). The instrument well fixed on the tooth, the attachment is broken up by the inward and outward movement, the rotary being seldom applicable, since, in general, the roots are flattened, and in many cases quite thin, so as to be incapable of turning in the socket. Care must be exercised in the oscillating movement, and especially where the tooth to be extracted stands out of the proper position, and the contiguous teeth incline together; though this is of little consequence where the teeth are all to be removed. When the crowns of these teeth are short and thick, the roots are shorter, thicker, more conical, and more nearly cylindrical; and, in the extraction of such, the rotary may be combined with the oscillating movement.

Roots.—There is seldom any superadded difficulty in the removal of the roots of these teeth, the same instruments and movements being applicable as to the removal of the teeth themselves. The only difference in any respect is, that where the teeth are decayed off far down, the forceps should be forced down on the process, in order to obtain a firm hold on the root. Neither the elevator nor the screw is ever required for the removal of these roots.

INFERIOR CUSPIDS.

These teeth may be removed with the inferior-bicuspid forceps of the right side; though an instrument of the same general form, but of less curvature would be preferable, since with such, the required movement for breaking up the attachment could be more easily given. They commonly have long, round, conical roots, not so large as those of the superior cuspids, nor so difficult to extract—seldom having any curvature, and thus being susceptible of detachment by the rotary motion. They often stand so much anterior to the true circle, that an attempt to thrust them inward, would be liable to break or loosen the lateral incisors. Their situation, as indeed that of all teeth, should be strictly attended to before any attempt is made to remove them.

The crowns of these teeth decay off, and leave the roots standing, far more frequently than do those of the superior cuspids. But there is no difficulty in the removal of their roots; and the only indication is, when they are deeply decayed, to pass the forceps far down on them, either first cutting away the process or embracing it, as the circumstances may warrant; the former method being preferable. After the root is extracted, the fractured pieces of process, if any, should be removed.

A long, tapering screw may sometimes be advantageously used for the extraction of these roots, when they are decayed so deeply that an extensive breaking-away of the process would be incident to their removal with the forceps. The elevator, however, is rarely ever called into requisition here.

INFERIOR BICUSPIDS.

These teeth, two in number on each side, have but one fang, and that generally round, or nearly so, and not so long as that of the cuspids; and have less diameter at the neck than they. They require, in extraction, forceps for each side, as already described (see Fig. 47). They may be removed either by the rotary, or by the inward and outward movement, or by both combined. With the handle of the forceps thrown very far out of a line with the axis of the tooth, this is always more difficult to be rotated accurately in its socket; a straight instrument is best for the rotary motion. In the removal of these teeth from the right side, when the mouth is small, care should be taken that too much pressure is not made against the anterior tooth. This accident is more liable to happen in the removal of the second bicuspid, than in that of the first, and especially if the mouth can not be opened wide. As the tooth comes out, the forceps are liable, without some attention, to strike the superior teeth, and in this way fracture them or scale off their enamel. In many cases, forceps with a forward and an outward curvature combined, would be very desirable, for facility of approaching the tooth; but with such a complication of curves, the operator loses control of the instrument.

In the removal of the bicuspids of the left side, there is little or no liability to undue pressure against the anterior teeth; and in their extraction, the movement should be mainly inward and outward, since the great curvature of the forceps renders a rotary motion very difficult and uncertain. There is also danger here of striking the upper teeth, especially if the tooth to be extracted comes out with less effort than the operator anticipated; an accident that sometimes befals the most skillful and discriminative. The first and the second inferior bicuspids are removed with about equal facility.

Occasionally, though seldom, these teeth have two distinct, well-defined roots; a condition that can not be determined by the form of the crown or by any other visible indication; and one tooth alone will sometimes be found with this peculiarity. The removal of the roots of these teeth is not attended with much difficulty; the main consideration being, to obtain a deep, strong hold on them, and then apply a firm, steady movement.

INFERIOR MOLARS.

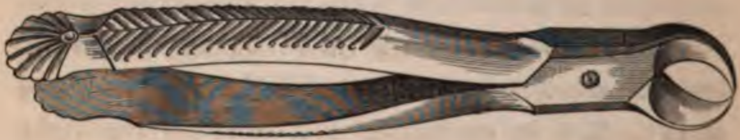
These teeth commonly have two fangs, a posterior and an anterior; the latter being the largest, and frequently the longest. The roots have different inclinations to the axis of the tooth, being in some cases divergent from, and in others parallel with it, and in others convergent, or curved together so that their points almost meet. The forms of the crowns will give some indication of the inclinations of the fangs: if those are short, these are so, and *vice versa;* if the diameter of the crown is about the same at the masticatory surface and the neck, the fangs do not diverge; if the crown is *long* and of uniform diameter, the fangs will be either parallel or convergent; and if the angles on the crown are not sharp and well defined, the roots most probably curve together at the points. If, however, the angles formed by the masticatory and lateral surfaces of the teeth are sharp and well defined, the roots generally diverge.

Forceps adapted to each side are required for the removal of these teeth. These forceps have a prominence, or point, in the center of the beaks, to pass into the bifurcation; and, in separating the gum, it is important to dissect it away, and, if need be, even cut away the margin of the process, so that the bifurcation may be well exposed, to admit the forceps to a proper position on the tooth, without obstruction. The tooth being firmly grasped in the proper manner by the forceps, is moved gradually, but steadily, inward and outward, to break up the attachment, and then drawn from its socket. In the removal of these teeth from the right side with the ordinary forceps, there is great danger of undue pressure on the anterior contiguous teeth; which is to be avoided by directing the pressure backward in the operation. And there is also danger of injuring the upper teeth with the forceps; which may be obviated by wrapping the joint of the instrument with a small napkin.

In the removal of the inferior molars of the left side, the application of force is the same—an inward and outward movement—but the handles of the forceps occupy different relative positions to the teeth to be extracted, passing directly out at the front of the mouth, in stead of at one side. In consequence of this arrangement, the operator can not exert the same force on them, as, with the proper forceps, on those of the right side. Very little traction can be employed in connection with the oscillating movement, but the attachment must be almost wholly broken up before beginning to lift the tooth from the socket. But in extracting the teeth on the right side, with the proper forceps, traction is always combined with the to-and-fro movement.

In the extraction of the roots of these teeth, little difficulty is experienced after the decay has proceeded so far as to effect their separation. They are then embraced with the appropriate forceps, and removed as single roots are elsewhere. These forceps have narrow, thin, sharp beaks, turned to almost a right angle. With them, the root is embraced, and moved inward and outward till loosened, and then removed. When the mouth is large, and can be opened wide, the slightly curved root forceps are convenient, and the rotary movement may be employed with them, if the roots are not very much curved, flattened, or firmly set. The removal of these roots is more difficult when the bifurcation is low down, and the roots remain firmly attached together, and especially when they diverge. If the bifurcation is not too low, and the attachment not too firm, the roots may be separated with the separating forceps (Fig. 63), and then removed singly, as in other cases. This is the preferable method, when there is much divergence; but if the fangs can not be separated, they may be extracted with the forceps shown in Fig. 52. The round, curved, sharp beaks are passed down between the roots, and the whole is removed at once; the attachment being broken up on the principle already described.

Fig. 63.



These teeth sometimes have but one, large, round, conical fang; and there is seldom, if ever, enough curvature of the roots to render extraction difficult.

The ordinary inferior-molar forceps are not well adapted to the purpose; for the central points of their beaks will prevent a perfect adaptation. The broad, single-concave, beaked forceps are best adapted; the curves and general forms of which, except the beaks, are the same as those represented in Fig. 49. The removal of teeth with this kind of roots is easily accomplished. Rotary movement would be applicable here, if the exact form of the root could be ascertained before extraction; but it is, in general, the safest course to employ the inward and outward movement.

INFERIOR DENTES SAPIENTIÆ.

These teeth require, for their removal, the broad, single-concave, beaked forceps, the beaks curved at a right angle with the handle, and the handle straight. This instrument fixed deeply and firmly on the tooth, the attachment is to be broken up by the inward and outward movement. These, more frequently than the superior *dentes sapientiæ*, stand out of the proper position; their variations and the manner of obviating the attendant difficulties, however, being about the same—at least, so far as deviation is concerned. Physic's forceps may be used here with greater facility than on the upper teeth.

These teeth frequently exhibit but a very small portion of the crown through the gum. Being erupted with an anterior inclination, the tooth comes in contact with the posterior portion of the second molar, and is thus checked in its external development. Thus the crown is left partially covered with the gum, which frequently inflames, and even suppurates, remaining in that condition for a considerable time, to the great annoyance of the patient. Such teeth are difficult to remove; first, because of their inclination and contact with the second molar; and secondly, because the crown is more than half below the borders of the thick, firm alveolus, rendering it impossible to obtain a firm hold of the tooth, without cutting away a portion of the alveolus. In such cases, it is generally best to make a free excision of the alveolus all round the tooth, sufficient to permit its easy removal.

EXTRACTION PREPARATORY TO THE INSERTION OF ARTIFICIAL DENTURES.

Whenever there is a number of teeth to be removed, the method and the duration of the operation will depend on the following circumstances: first, the number to be removed; second, the firmness of their attachment; third, the patient's power of endurance; and fourth, the manner in which the immediate parts are affected. Where the number to be removed is considerable, and the attachment is feeble, or not very firm, and the patient's power of endurance good, the extraction may be as rapid as is consistent with efficiency. In many such cases, from three to six teeth may be removed, without any relaxation, by the operator, of his hold on the parts with the left hand. This is generally practicable with the front teeth of the lower, and frequently with those of the upper jaw; but it is not proper to remove more than three or four of the molar teeth, without respite, even when they are quite loose, or have but a feeble attachment in the socket. The gum should, of course, be well separated previously to the operation. Only so many teeth should be removed at one sitting as the nervous system will allow without too great a shock. In many instances, however, it is practicable, so far as this is concerned, to remove at once all the teeth in the mouth. In the extraction of a large number, those most easily removed should be first taken, so as by degrees to bring the patient to severer operations. If there is a manifest hemorrhagic diathesis—a disposition to bleed freely from the capillaries, as well as from the larger vessels—but two or three teeth should be removed at a sitting, lest uncontrollable hemorrhage ensue.

After all the teeth are removed from one or both of the jaws, the gums and alveolus should undergo a trimming process: all detached, flabby, or prominent portions of the gums should be dissected off; the whole ridge made uniform; all loose portions of the alveolus removed; all the prominent points and sharp edges cut down; and the whole border of the process rendered as smooth and even as possible. By this means, the healing of the parts is facilitated, and they assume the desired condition and form in much less time, and with far less soreness and inconvenience.

CONDITIONS TO BE OBSERVED IN THE EXTRACTION.

Such conditions are often found to exist in the system, as indicate the necessity of great care in the operation, or of prior treatment, or forbid the extraction of the teeth altogether. Of these conditions, the following are some of the more obvious:

Extreme debility.

Great nervous irritability.

Excessive local inflammation, especially where it tends to the other parts.

Much irritability of the parts intimately connected with the teeth.

Pregnancy, and all uterine irritations.

A tendency to epilepsy.

In many cases, where there is great debility, so painful an operation as the extraction of a tooth, will cause extreme, and sometimes alarming prostration. This, however, may be anticipated, by prior invigorating treatment, continued till strength and tone are obtained sufficient to endure the operation. This treatment may occupy considerable time; while an urgent case may arise, in which the removal of the offending tooth is immediately demanded; in which case, it is proper to administer stimulants—brandy or wine, or such as the case may seem to require. By such means, the system may be so invigorated as to withstand the shock of the operation with comparative fortitude.

There is in some cases a highly irritable condition of the nervous system, that almost absolutely forbids the extraction of teeth, convulsions being sometimes produced, in such cases, by a simple operation. This remark does not of course apply to facial neuralgia that may be either partially or wholly produced and kept up by diseased teeth; neither general nor local neuralgia would be aggravated by an operation of this kind. Accompanying general nervous irritability, there is usually excessive dread of an operation, such as to occasion rapid prostration—even greater and more rapid than that caused by the operation itself. In such cases, if the extraction is effected immediately, it will give relief; but where the excitement has been very high, and the tension for some time great, the depression after the operation will be correspondingly great, and considerable time be required for complete recovery; indeed, the shock is sometimes so severe as to occasion confinement for several days. Treatment for quieting the nervous system, consisting in agents of a sedative, nervine character, may be employed previously to the operation: stimulants, as a general rule, should be avoided.

Where there is a high state of inflammation in the immediate parts, especially if there is a general inflammatory diathesis, the propriety of extracting the teeth is questionable. Under such circumstances, there is probably less danger in the extraction of the inferior teeth, than of the superior. Where the inflammation has a disposition to extend, it is liable to go to the head from the superior maxilla, and to the fauces and throat from the inferior. In cases, then, where there is excessive inflammation in the immediate parts, accompanied by a general inflammatory condition, both local and general antiphlogistic treatment should be adopted.

Extreme irritability, or a diseased condition of parts having an intimate connection with the teeth, as the immediate surrounding tissues, the salivary glands, and the throat, is a circumstance admonishing to great caution in the extraction of teeth, especially when such condition does not depend on the teeth for its exciting cause or modifying influence. It is, however, very generally the case, when any of the parts having an intimate relation with the teeth, become in any way affected, diseased teeth will exercise an injurious influence on them. If the necessity for the removal of the offending tooth is not too urgent, the parts that may be diseased about it, should be brought to as good a condition as possible.

Pregnancy and uterine irritation frequently produce strong sympathetic influences on the teeth, and especially on those which are in an irritable condition: even sound teeth may be thus affected, so as to occasion great annoyance. Such teeth are frequently presented for extraction; but these cases should always be thoroughly examined before deciding as to the propriety of an operation. As a consequence of this sympathetic connection between the teeth and the uterus, the latter, when in an irritable condition, is very liable to be affected by any special violence to the former. In many cases, under such circumstances, the extraction of a tooth is attended with pain in the uterus; and in cases of pregnancy, where there is debility of the parts involved, abortion is liable to follow the operation. It is the duty of the patient, under such circumstances, to notify the operator of the condition; or, if the latter has any knowledge of it, it is his duty to become fully acquainted with the circumstances, and then to conform to the indications. In such case, treatment will avail but little to prepare the system for the operation. The better method is to adopt palliative treatment;

which, if the affection is wholly sympathetic, must be directed to the organ producing the difficulty. But if the affection is in part local, then topical treatment is also indicated. When there is a suppression of menstruation, there will be an increased disposition to hemorrhage; and in the extraction of the teeth of a patient of hemorrhagic diathesis, this is a point to which observation should be very specially directed: here, of course, a remedy for the obstruction would meet the difficulty.

Persons subject to epilepsy should be very cautiously treated in all operations on the teeth, and most especially in their extraction. It is not probable, however, that an operation of this character would increase the tendency to epilepsy; but any undue excitement is liable to produce a paroxysm of the disease; and hence the operator should proceed to his work with as little parade as possible; yet, not stealthily; the patient should be thoroughly aware of what is to be done; for, of all patients, such a one is the last that should be deceived. Of course, in a case of this kind, there can be no prior treatment that will avail anything; the most that can be done, is, to await the fittest opportunity in respect to the paroxysms. There is no more liability to fatal results with such patients than with others.

CHAPTER XII.

ACCIDENTS IN THE EXTRACTION OF TEETH.

THE accidents liable to occur to the teeth and the contiguous parts in the operation of extraction, used to be far more frequent than they are at present. This difference results from the existence of more perfect instruments and of more accurate and extensive knowledge. Formerly, no one studied the peculiarities of the teeth, either in their physical or anatomical structure; their peculiar forms, as indicated by their crowns; their anatomical and physiological relations to the contiguous parts and to one an other; and their attachment as affected by the character and structure of the tissues about them. The instruments employed, too, were, till within a few years past, very crude in their forms, very inapplicable in that part which embraces the tooth, inappropriate in their shapes, and defective in their manner of applying the force in the operation. But these causes of accidents, so far as the better part of the dental profession is concerned, have been in a very marked degree diminished.

Some of the accidents attendant or consequent on the extraction of teeth, are of a grave character. Permanent deformity has sometimes been occasioned by extensive laceration of the soft parts, or by fracture of the alveolus and of the maxilla. Intense and protracted suffering frequently, and death sometimes, follows such accidents.

HEMORRHAGE.

Excessive and obstinate hemorrhage in some cases follows the extraction of teeth, occasionally resulting seriously, and even fatally. There is in some constitutions a hemorrhagic diathesis, such as that from a small wound, or even a scratch, there will ensue persistent bleeding. This condition is dependent, first, on a lack of tone in the bloodvessels, so that they fail to contract at an injured or ruptured point; and secondly, on a peculiar condition of the blood, such as to form coagulum with difficulty, as, when there is a relative deficiency of red corpuscles. It is one of the most important duties that ever devolve on the dentist, to make a correct diagnosis in cases where there is a tendency to hemorrhage. Close attention to the following points, will assist much in arriving at a just conclusion. In persons of a hemorrhagic tendency, there is a lymphatic, serous temperament; a lack of tone in the soft parts—a soft, flabby condition; the skin pale, and devoid of the bright, vital appearance; the eyes and hair of light color; and the flow of saliva and mucus abundant. Besides these indications, much may be learned sometimes by properly directed inquiries of the patient in regard to a disposition to hemorrhage on being wounded, either in his own case, or in that of his relatives; if in the former, under what circumstances; whether from an extensive or a slight wound; from large or small vessels—from arteries or veins; or, whether it occurred immediately, or after the lapse of some time. If the patient has never met with an accident sufficient to occasion excessive hemorrhage, and any of his relatives have, and a tendency to bleeding is suspected in the case, the operator should ascertain whether there is a similarity of temperament and constitutional tendencies between the patient and such relative.

There are certain circumstances in which excessive hemorrhage would be more likely to occur than in others; as, for instance, when there is an accidental relaxation, or lack of tone, in the system, especially the vascular system; and also, when there is a suppression of any periodical discharges. There may be excessive hemorrhage from a ruptured vessel when there is no constitutional hemorrhagic tendency. There is sometimes a local difficulty with the vessels —a lack of tone in the part—on account of which obstinate hemorrhage will occur. A peculiarity of this kind is not very readily recognized.

Violent passion, and, indeed, any strong agitation of the mind, will aggravate hemorrhage. Improper medication, as well as highly stimulating food, will have the same tendency. Anything that will increase the circulation, or reduce the tone of the vessels, or change the condition of the blood, will increase the liability to hemorrhage. Simple determination of blood to a part, however, would not indicate such a liability. When there is a special hemorrhagic diathesis, the blood will flow from all the wounded surface, will be thrown out from all the ruptured capillaries. The most difficult cases are those in which there is a defect both in the vessels and in the blood. Usually, in such cases, there is a lack of red corpuscles in the blood, from which cause it does not normally coagulate. If the blood is in a good condition, it will coagulate in ruptured capillaries, though they might be deficient in tone; but in larger vessels, though coagula might be formed, it would not be retained.

TREATMENT.

In cases where there is manifest hemorrhagic diathesis, prior treatment is indicated, if the necessity of extraction is not urgent; and that treatment will be determined by the peculiar condition of the case. If there is a lack of tone in the vessels—an inability to contract—then the treatment should be of a tonic character; and, if the blood is in good condition, this is the only treatment necessary; but, if in a vitiated state, other treatment will be demanded; the object of which is to produce an increase of red corpuscles. It is always better to postpone the operation, if at all practicable, till such treatment can be had as will bring the system to the best possible condition.

Of the several methods of arresting hemorrhage, the proper one in a given case will be determined by the circumstances. Styptics, or astringents, applied directly to the ruptured surface, will often be found to produce coagulation of the blood, and thus stop its flow, without anything else. This kind of remedy will be efficient in those cases in which the application will produce contraction of the bleeding vessels, as well as coagulation of the blood. Sometimes this class of agents will fail to accomplish the object; in which case, in addition to them, compression should be made upon the part. Indeed, in many cases, the compress will effect all that is desired, without any other application.

There are several methods of applying the compress; but the one best adapted to any given case, will be determined by circumstances; such as the extent of the wound, the character of the hemorrhage, the location of the injury, and the size of the mouth.

A very common method of making compression in the socket from which a tooth has been drawn, is, to force into the cavity pledgets of cotton, or small strips of linen, tightly, till it is full. It is well to saturate these with a solution of tannin, or some astringent preparation, applying it, too, in connection with the compression. In some cases, a simple packing of the cavity in this manner, is quite sufficient; but, in others, it is necessary to retain the pledgets in the socket by means of further compression. This is effected by placing a roll of linen, or perhaps better, a properly formed piece of cork on the packing, and then closing the jaws tightly upon this, and, if need be, placing a bandage under the chin, and tying it firmly over the head. The length of time during which it will be necessary to keep the jaws thus together, will depend on the nature of the case—from one to six hours. After the hemorrhage has entirely ceased, the bandage is to be removed carefully, and the patient instructed to hold the jaws together on the compress for a time, and then gradually to open the mouth, and remove the cork with much caution. After this, the packing should remain in the socket from one to three days, and then be removed very carefully, one piece at a time, lest the ruptured vessels be opened up and the hemorrhage caused to recur.

The object in applying a compress is to bring it to bear upon the aperture of the wounded vessel, and in this way to prevent the escape of blood, till coagulum is formed and the opening permanently closed. The operator should ascertain the precise point from which the blood flows, and form the compress so as to bear full upon it. If the flow is from all the wounded surface, then the compress must be made to conform exactly to that throughout.

An other method of making the compression, is to force softened wax into the socket, so as to fit it perfectly; remove it and chill it in cold water; and then introduce and make compression upon it in the manner already described, following, throughout, the general directions. An other, and probably better method, is, to form cones of wax cloth, as near the shape and size of the root removed from the socket as possible. This material is prepared by dipping thin linen into melted beeswax, withdrawing it and letting it cool, and then cutting off strips of from a fourth to a half an inch wide, and rolling them into the proper size and shape. Having softened this material by heat, and freed the socket of coagulum, introduce and press it firmly into place, making the compression on it as already directed. This makes a very efficient compress for many cases.

Plaster of Paris is sometimes used on the principle of a compress. Having the plaster mixed of the already described. It is sometimes difficult to obtain an accurate fit for the plate, so as entirely to prevent the blood from continuing to ooze out. In such cases, make the plate to conform as nearly as convenient to the part; then fill up its concavity with plaster of Paris, mixed to a proper consistence; and then place the whole upon the part, till the plaster conforms exactly to it, and retain it there till the plaster sets. This is then used for the compress. Or the inside of the plate may be thickly coated with softened gutta percha, in stead of plaster, and pressed upon the part in the manner already described, and employed in the same way.

It will often require considerable discrimination to determine the best method of obtaining compression. Very great difficulty is occasionally experienced when a portion of the process has been broken away, or the soft parts have been lacerated.

Various preparations are used as hemostatics. These agents serve to check hemorrhage in two ways: first, by facilitating a coagulation of the blood; and secondly, by producing a contraction of the orifice of the ruptured vessels. It is proper in all cases to use styptics in connection with the compress. The following agents have been used as styptics: tannic acid, creosote, nitrate of silver, chlorid of zinc, sulphate of zinc, oil of turpentine, muriate of iron. The methods of applying these different preparations are the same. The agent is simply to be retained in contact with the part till it has exerted its influence. A solution of tannin in alcohol with creosote, equal parts, makes a very powerful styptic.

The actual cautery is sometimes used to arrest hemorrhage; but the propriety of using it in cases where there is a manifest hemorrhagic diathesis, is exceedingly doubtful. When the scar produced by the hot iron is sloughed off, the hemorrhage is liable to occur with increased vigor, indeed, is certain to do so in almost every case when there is a strong predisposition. Constitutional treatment may be employed to anticipate hemorrhage; and it should have in view an increase of the relative amount of red corpuscles in the blood, and a diminution of the serous portion, and also the production of a normal tone of the system. Saline purgatives may be used with very decided advantage, followed with acetate of lead, in connection with opium; the effect of the lead being to increase the coagulability of the albumen and fibrin. Care should be exercised, however, in its administration.

Excessive hemorrhage will sometimes occur from very slight wounds; death has been known to ensue from simply scarifying the gums. Mr. C. desired the removal of the first superior molar. The gum was separated from the neck of the tooth with the lancet, in the usual manner, when he refused to have anything further done, and left the office, there being a slight discharge of blood from the gum. After a few hours, the hemorrhage increased so as to cause alarm to the friends. The patient was some eight miles from a dentist, and a physician of rather moderate skill was called to the case. He probably did as well as he knew how, but failed to arrest the hemorrhage, and succeeded in convincing the friends that no one else could do any better. The flow of blood continued for from three to four days, proving well-nigh fatal, but at last abated, and the patient recovered. In this case, a properly directed compress would have checked the bleeding in a few minutes.

Another case: Mrs. T. had nine teeth removed. The operation was not followed immediately by unusual hemorrhage; but, within two or three hours, the flow of blood had increased to an alarming extent, so as to run from the mouth in a continuous stream. The indications were that the patient would soon die. She had become very weak. On examination, the blood was found issuing only from the socket of one root of an inferior molar. The mouth and socket being cleansed of blood and coagula, it was perceived that the hemorrhage was from a small artery at the bottom of the socket, spouting out in jets with the pulsations. The treatment consisted in rolling up pledgets of cotton very tightly, saturating them with creosote and tannin, and forcing them in on the bottom of the socket, so as to make compression upon the bleeding vessel. The socket was then filled up, compression made, and the head bandaged in the manner already described. Thus the hemorrhage was immediately checked, and no recurrence ensued. The constitution of this patient was of a scorbutic diathesis.

Excessive bleeding often does not occur till considerable time after an operation; and it may come on without any exciting cause, or be induced by vigorous muscular exercise, or by any intense mental excitement. Everything of this kind should be avoided, where there is a predisposition to hemorrhage, and everything invited, that would tend to maintain the equilibrium of the circulation and the utmost quiet.

FRACTURE OF THE ALVEOLUS.

The ordinary fracture of the alveolus is a matter of no considerable consequence, if it receives proper attention. This fracture occurs to a greater or less extent under the following circumstances: first, when there is great divergence of the fangs, so that the tooth cannot pass from its socket, unless one or more of the roots are broken off, or the alveolus fractured; second, where the tooth is forced out of the socket at a very considerable angle with its axis; third, where the alveolus is very firmly attached to the roots, and is very thin toward the points of these. Usually, the fracture is of that part which forms the socket of the tooth removed; and when this is the case, it is of but small moment. It sometimes, however, extends far beyond this, involving the alveolus of from one to four of the adjacent teeth, and causing very serious injury, even the loss of the teeth themselves. Extensive fracture, however, is far less liable to occur now, than when less perfect instruments were employed. When the key was in such general use, extensive fracture of the alveolus was frequent; but with the forceps, it is comparatively rare.

When an accident of this kind does occur, all of the detached portion, whether large or small, should be removed. A pair of bone nippers will answer for this purpose. If there is much attachment to the soft parts, it should be dissected off, and then removed. If such fractured portions are permitted to remain, inflammation, and oftentimes sloughing of the gums, will ensue; and necrosis of the bone is also sometimes produced by detached bone remaining in contact with the living.

Sometimes extensive fracture occurs, involving the adjacent bony structure. In the case of Mr. W., in an effort to remove the first superior molar, the outer wall of the alveolus was separated from the other teeth. The fracture extended almost to the zygomatic process, and detached a portion of the floor of the antrum, as well as a part of its outer wall. After the removal of this detached portion, there was a considerable external depression, that very much marred the form and symmetry of the face.

Fracture of the alveolus should always be guarded against as carefully as possible. It always makes an unfavorable impression on the mind of the patient, which in many cases no explanation can obliterate. Whenever the accident does occur, the disagreeable knowledge of it may, if practicable, remain a secret with the operator.

LACERATION OF THE GUMS.

The gums are often bruised and lacerated with the key in the extraction of teeth. But this accident seldom happens with the forceps; indeed, never, unless the gum is very firmly attached to the neck of the tooth, and has not been separated with the lancet. The gum will sometimes be lacerated by adhering to a piece of the process, while the tooth is drawn from its socket, with the process and gum attached. With the various hooks and punches, the gums, lips, and cheeks are sometimes wounded. Accidents of this kind are to be prevented by placing a finger of the left hand, or a guard made of a roll of linen, in front of the instrument. When any considerable portion of the gum is lacerated, the detached portion should be cut off. The worst consequences from laceration of the soft parts occur where there is a hemorrhagic diathesis. The most effectual means of preventing accidents of this kind is to separate the gum perfectly, and guard well the points of the instrument.

BREAKING THE TEETH.

This is an accident of no small consequence, and is liable frequently to occur in the use of imperfect, ill adapted instruments, or in the unskillful use of good ones. It is of very common occurrence when the key is employed for extracting, even in the hands of those who claim to be skilled in its use. And with forceps, too, of the primitive form, the teeth were so frequently broken, as almost to preclude their use as extracting instruments. This accident usually occasions great pain to the patient, as well as protracts the operation, and diminishes his confidence in the ability of the operator. One such accident will create more prejudice than fifty skillful operations can obliterate.

In all cases where a tooth is broken, the root, if possible, should be removed; for, if it be not, continuous or periodical pain, inflammation, alveolar abscess, and the like affections, are liable to ensue.

The remark is often made, when teeth are broken, that the gums will close over the roots and thus effectually protect them, and no disagreeable consequences will follow. In no ordinary case will the gums unite over even the smallest portion of root that may have been left in the socket.

REMOVAL OF A WRONG TOOTH.

There is very rarely any excuse for the removal of a sound, healthy tooth in the immediate vicinity of a diseased one, unless it be in a case of those deep-seated, hidden affections which are difficult to diagnose. It sometimes happens, however, that a sound tooth is removed; and when a mistake of this kind is made, the diseased tooth should also be at once removed, and then, if the conditions are favorable, the healthy one should be immediately replaced. The circumstances most favorable for such replacement, are, a good constitution in a state of health, and a normal condition of the mouth, especially of the gums and mucous membrane, so that the attachment would take place with as little inflammation and soreness as possible. If the tooth is necessarily kept out of the mouth many minutes, it should be placed in cold water; and before the replacement, the socket should be thoroughly cleansed of coagulum. The tooth is then introduced, pressed firmly to place, and allowed to remain without disturbance or irritation, till the attachment has become complete. During the time it is reuniting, treatment may be required to counteract inflammation. Meager diet, abstinence from stimulants, and quiet, should always be recommended in the case.

This operation has been wholly condemned by some very good dentists. Dr. Koecker declares that it should never be attempted. But numerous successful cases, well attested, give assurance that it may very frequently be accomplished with the most satisfactory results. Mr. T., aged 15, of good constitution, and in good health, and with the mouth principally in a normal condition, had the second inferior bicuspid of the left side removed by mistake, the first molar being the offending tooth. The former was at once put into cold water, and the latter forthwith extracted. The socket of the bicuspid was then cleansed, and the tooth replaced. There was slight soreness for a few days, after which the tooth was found to have made a firm and permanent reattachment; and from that time to this—sixteen years—it has remained perfect, and is now as healthy, lifelike, and valuable as any other tooth in the mouth.

DISLOCATION OF THE INFERIOR MAXILLA.

The dislocation of the inferior maxilla is an accident of not very frequent occurrence. In persons of lax muscles and with large mouths, the operation of extracting teeth is liable to produce it; sometimes when the operation is on the upper jaw, but more frequently when it is on the lower. In the former case, it is an effect of the patient's effort to open the mouth; but in the latter, generally that of the movement of the jaw by the instrument. The dislocation consists in a downward and forward movement of one or both of the condyles, so that they are thrown out of their sockets, and rest in front of the anterior rim. In such case, the mouth is distended to its utmost, the chin thrown down on the breast, and deglutition and speech rendered impossible. Sometimes but one condyle will be thrown out; in which case the jaw is thrown downward and to one side.

This accident seldom or never occurs with patients who have small months or firm muscles. When it does happen, however, the dislocation should be promptly reduced. Of the various methods of accomplishing this reduction, the one most commonly employed, which is very efficient, is as follows: if both condyles are dislocated, place corks, or some similar substance, between the superior and the inferior molar teeth of both sides; and then, with the fingers of both hands, make firm, steady pressure on the chin upward and backward, thus shoving the condyles downward and backward into their proper places.

If but one condyle is out, the cork should be applied only on that side, and in the same manner already directed. An other method is, to substitute the thumbs of the operator for the corks, placing them in the same position between the teeth, and manipulating with the fingers on the chin, as before. The patient should be placed in a recumbent position for the operation. An other method is, to make downward and backward pressure on the coronoid process, and in this manner cause the condyles to glide into their places. This accomplishes the reduction without taking hold of the jaws, or placing a fulcrum between them.

This accident is far more liable to occur the second time in the same case. In extracting the lower molar teeth for one who has suffered a dislocation, or is predisposed to it, the lower jaw should be very firmly supported with the left hand; or, the accident may be prevented by placing a bandage under the chin, and over the head, so that the mouth can not be opened to its furthest extent; and this is the surest method. In all cases after an accident of this kind, the patient should abstain from solid food for a few days, or at least till the soreness is abated, and avoid everything promotive of inflammation.

SYNCOPE.

Syncope, or fainting, is frequently brought on by extraction of the teeth, and even by other operations upon them; indeed, it is sometimes produced simply by cutting the gums, or by the sight of blood, or, in some instances, by dread of the operation. It consists in an intermission of the heart's action, and consequently irregularity of the circulation of the blood, accompanied with a temporary suspension of the functions of the brain and a loss of consciousness. Difficult or suspended respiration, lividness of the skin, and inability to move, are the external indications of the condition. There are no constitutional appearances known, by which a predisposition to syncope can be determined: persons of all apparent conditions and peculiarities are subject to it. The most strong, robust, and healthy sometimes faint under the most trivial influences; while others, of the weakest and feeblest constitutions, can not be brought into this condition by any ordinary means; so that nothing can be predicated of appearances as to such predisposition. The fainting may occur once or twice in the same case, even under the most simple operation, owing to some temporary condition of the system, and never happen again under any circumstances whatever.

It sometimes comes on before, sometimes after, and sometimes during, the operation. There is greater liability to it after a recent meal than after digestion is completed, since the nervous energy, during digestion, is directed to the stomach and its appendages, and thus the circulating apparatus has less of nervous force.

The frequent occurrence of syncope indicates a constitutional predisposition to it, and may enable the operator to anticipate it to some extent, by the aid of stimulants, such as brandy, or, what is in some respects preferable, a galvanic current. The patient subject to such affection, should be placed, for an operation, as nearly as practicable in a recumbent position—especially for the extraction of teeth—and his mind kept as tranquil as possible.

To restore the patient from syncope, place him in a horizontal position, the head quite as low as the body, and apply volatile stimulants to the nostrils, and dash water on the face and chest. All compression should be removed from the body, especially from the chest, as it would constrain the action of the respiratory muscles. This remark is peculiarly applicable to female patients. This treatment will usually be quite sufficient to effect a rapid reaction and resuscitation.

CHAPTER XIII.

ANESTHETICS.

ETHER—CHLOROFORM.

SULPHURIC ether was the first agent successfully employed for producing insensibility to pain during surgical operations. It was brought to the notice of the profession in 1846 by Dr. W. G. L. Morton. The mode of administering it is, by inhalation of the vapor; and it produces its effects in a short time, depending on the quality of the ether, the amount of air introduced with it, and the susceptibility of the patient. A complicated instrument, denominated an inhaler, was first employed for its administration; but it soon became apparent that this was not at all necessary, and that simpler methods were preferable, because more easily regulated and adapted to circumstances. The best method is, to inhale it from a sponge or napkin, since, in this way, the admission of the air can be controlled entirely by the will of the operator, graduating it to the requirements of the case.

During the administration, the patient should be in a reclining posture; though it is held, by much good authority, that a horizontal position is the safest, because, in that, the force of the circulation is most nearly equalized. In the administration of general anesthetics, the circulation is always more or less affected. It is an opinion very generally received, and probably correct, that, where there is functional derangement of the heart, lungs, or brain, general anesthesia should not be employed. This opinion, however, is perhaps derived more from analogy than from actual observation. It is true that, other things being equal, the liability to injury in such case would be greater; but the danger with both ether and chloroform is, that there are cases in which there is an undefinable and undetectable idiosyncracy, or malsusceptibility of its influence, to a great extent independent of pathological conditions.

The patient having been placed in a comfortable position, and his mind freed as far as possible from apprehension, he should be directed to breathe tranquilly by full inspirations, carefully guarding against any compression of the chest, so as to allow the respiratory muscles free play. During the administration of the anesthetic, a strict watch must be maintained over the patient, having reference to the following points: the breathing should be free and easy, without irritation of the throat or bronchia; the skin should not become blanched, but should retain a florid, lively color; but the great criterion is the pulse, and the indications given here should be strictly observed and obeyed. In order that the operator may follow every indication, he should be familiar with the manifestations of the pulse in different constitutions, and under different circumstances. During the administration of ether or chloroform, the pulse usually becomes more frequent; but it should not be much accelerated, nor its strength and fulness be much diminished. Enfeebled or irregular pulse should in all cases be regarded as a warning; and if the feebleness and irregularity be very marked, the operator should desist. In some instances, death has occurred after a few inhalations; but perhaps only in the use of chloroform. This fact intimates that the first effects of the administration should be very closely noted.

The degree to which the anesthesia should be carried, is a matter about which there is much diversity of opinion. Every condition of it, from that of simple allayed irritability to that of complete insensibility and unconsciousness, has its advocates. But the extent to which the administration may be carried, will be suggested by the indications already referred to, and, if these are unfavorable, should be determined at once. Mere nausea, however, without any other unfavorable symptom, is not a counter-indication in the use of ether or chloroform.

The method of administering chloroform is the same as that for ether, except that, in the use of the former, more care and closer observation are required. Chloroform is more rapid and powerful in its action than ether, and hence more liable to do injury; but, independently of this fact, it is generally believed that the former is less safe than the latter, when taken into the system, especially by inhalation. A mixture of ether and chloroform, or chloric ether—usually equal parts of chloroform and ether, but the proportions are sometimes varied—is used by some; the object being to secure greater promptness than with ether alone, and incur less danger than with chloroform; and it is probable that a mutual compensation in these respects is thus to be attained.

If either chloroform or ether has been administered to entire unconsciousness, the patient should be permitted to pass out of the condition spontaneously; for, after such a revival, there will be less liability to unpleasant feelings, as headache, depression, and nausea. The fingers of the person administering the chloroform should be kept on the carotid, since the state of the circulation will be better recognized by this than by the radial artery, and it is a more convenient point for observation. In favorable cases, it is preferable to continue the inhalation till there is a muscular relaxation.

When a condition arises in which respiration is suspended, and the circulation partially or altogether stopped—a condition of imminent peril—active measures must be resorted to for the patient's restoration. Efforts must be directed to a recovery of the circulation, by friction, motion, etc.; but to restore the respiration, is the first, immediate, imperative consideration. Any or all of the ordinary methods of re-establishing suspended respiration may be employed. Cold water should be dashed in the face, and on the throat and chest, and volatile stimulants applied to the nostrils; the glottis should be titillated with a feather, or some such implement, to excite it to action; and artificial respiration, by some approved method, should be at once adopted. The galvanic current, too, may be brought into requisition, to excite the respiratory muscles to action, and to act also upon the circulation. In all cases of accident of this kind, prompt and efficient measures should be immediately taken; for a delay of a few moments may be attended with fatal results.

LOCAL ANESTHESIA.

Because of the frequently prejudicial and sometimes fatal consequences to which systemic anesthesia is liable, local anesthesia has been much brought into requisition; among the agencies for producing which may be first reckoned

Congelation.—Of the various freezing mixtures and implements applicable for this purpose, the apparatus chiefly used, and perhaps the best yet brought to the notice of the profession, consists of two parts of pulverized ice and one of salt, applied by means of an instrument of the following description : a vulcanized India-rubber tube, about five inches long and one inch in diameter, closed at its superior extremity by a screwcap, and open at its inferior, which latter is slightly enlarged and cut out, so as to leave two lips to reach down on the sides of the tooth; within the tube, a follower and a spiral spring, the latter forcing the former down to the open end. When this instrument is to be used, tie a piece of oiled silk or membrane loosely over its inferior end, fill it expeditiously twothirds full with the ice and salt, prepared as above, adjust the follower and spring in place, screw on the cap, and apply at once. The sac of the instrument is to be pressed and worked gradually down till it invests a portion of the gum on each side of the tooth to be extracted. As the ice melts in the sac, the follower forces the unmelted portion down next to the tooth and gum. The application should be continued from one to three minutes, or till the margin of the gum is congealed—as will be indicated by its hardness and whitened appearance—and then the tooth should be extracted as expeditiously as possible, though with all the ordinary skill and care.

If the contiguous teeth are sound, and not to be extracted, they must be protected as far as possible from the influence of the application—as they may be, by having their crowns enveloped in thin sheets of wax, oiled silk, or any other substance that is a nonconductor, and is not too bulky. Where some such protection is not afforded, great injury is liable to ensue.

If the tooth to be extracted is sensitive, the temperature should be reduced by holding in the mouth cold water, and finally a piece of ice; and immediately after, the instrument should be applied. When the pulp of the tooth is exposed, the application would be intolerable. In such case, it has been recommended first to apply arsenic for twentyfour hours to the exposed pulp. This method of procedure, however, will be found wholly impracticable.

Under the full influence of the freezing mixture, the circulation in the part is wholly arrested, and the sensibility entirely obtunded, so that the operation, properly performed, produces no pain. In the extraction, the gum, so far as congealed, may, if necessary, be embraced by the forceps and broken away without pain. After the operation, cold water or ice should be applied to the part, to prevent a too rapid reaction, which would be very painful, but which, thus graduated, occasions but slight pain, and in some cases none at all.

The aim in all cases should be to produce congelation to the very point of the root; for, without this, the extraction will cause pain. And it is far more difficult to effect this object where only the root, than where the crown is remaining; for this serves as a conductor. In the former case, however, a screw or iron wire may be introduced into the root, and left projecting, to serve as a conductor. But in some cases, especially in those of roots, it is improper to attempt the employment of congelation at all. The practicability of a desirable result will depend much upon the skill and tact of the operator, and the susceptibility of the parts. In patients of full habit and active circulation, it is very difficult to produce insensibility by congelation; and in such cases great pain usually attends its application.

EXTRACTION BY ELECTRO-MAGNETISM.

The employment of electro-magnetism in the extraction of teeth is of recent date, it being only about a year since its general introduction to the dental profession. In this time, however, it has been extensively used. There is a great diversity of opinion as to its efficiency for relieving pain; for, while some have been disposed to assume that, when properly employed, it would, in the generality of cases, mitigate pain, and, in the majority, obviate it altogether, others, after having thoroughly tested it, as they affirm, maintain that it does not produce insensibility to any appreciable extent, and consequently does not relieve the pain, but that, at most, it only complicates the sensations, the pain of the tooth-drawing becoming involved in the confusion of other feelings, so that the patient can hardly decide whether he has been definitely hurt or not!

In using this agent for the process of extracting teeth, the susceptibility of the patient to its influence must be carefully regarded. Some persons are so peculiarly constituted that an electric current is almost intolerable to them; while others will receive a strong current with pleasurable sensations. To the former, the electricity would be as painful as the extraction of the tooth; but to the latter, when properly applied, it mitigates, and in many cases altogether obviates, the pain. The reason of this difference in its action is not very clearly understood. Several theories in regard to it have been advanced, but none of them sufficiently plausible to challenge conviction.

Again, the manner in which, and the condition of the parts to which, this agency is applied, are to be closely observed. Where there is acute periostitis, an electric current, even though feeble, would produce intense pain, and should not be applied; though, in such cases, it has been suggested that an application of the charged sponge to the gums will produce insensibility.

APPLICATION.

The method of application is very simple. Any ordinary battery, of convenient form, may be employed for this purpose. It should be uniform in its action, and the vibration as short as possible. The common zinc-and-copper battery, with the sulphate-of-iron solution, is perhaps the most convenient and safe. One pole of the battery—no matter which—is attached to the forceps, and the other to a handle of size and form convenient for the patient to grasp. To ascertain his susceptibility, the current should always first be tested on the patient, by placing the handle and the forceps one in each of his hands, and letting it on first feebly, and then gradually increasing it till he experiences the sensation just beyond the elbows; when, finally, it is to be slightly weakened. The gum having been separated, the forceps, with its appendages, is adjusted to the tooth, the connection made by placing the handle in the patient's hand, and the tooth at that moment removed. It has been recommended by some to place the forceps on the tooth, and complete the circuit, as above, with the current very feeble, and then gradually increase it to the proper force for the operation. In some cases, perhaps, this would be the preferable mode.

An other method of producing insensibility by an electric current is, to place two moistened sponges, connected with the two poles of the battery, on the gum, one on each side of the tooth, keep them there a few moments, and then operate. This method, however, has not yet been sufficiently tested to ascertain its merits.

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